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Applicant SCHNEIDEWEND, Daniel, Richard et al	

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(71) Applicant *(for all designated States except US)*: THOMSON CONSUMER ELECTRONICS, INC. [US/US]; 10330 North Meridian Street, Indianapolis, IN 46290-1024 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: SCHNEIDEWEND, Daniel, Richard [US/US]; 11221 Tall Trees Drive, Fishers, IN 46038 (US). RANDALL, Darrel, Wayne [US/US]; 2324 West U.S. Highway 36, Danville, IN 46122 (US). McLANE, Michael, Joseph [US/US]; 720 Sherwood Drive, Indianapolis, IN 46240 (US). BROWN, Megan, Louise [US/US]; 11321 Rollings Springs Drive, Carmel, IN 46033 (US). WESTLAKE, Mark, Sheridan [US/US]; 13105 Connor Knoll Parkway, Fishers, IN 46038 (US).

(74) Agents: TRIPOLI, Joseph, S. et al.; GE & RCA Licensing Management Operation, Inc., P.O. Box 5312, Princeton, NJ 08543 (US).

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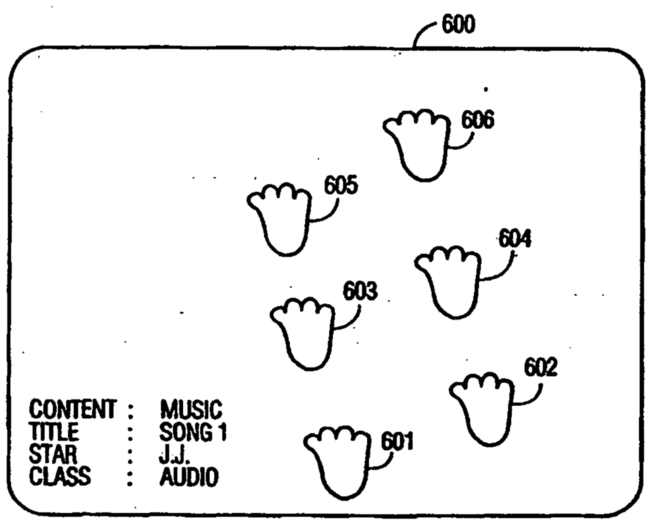

(57) Abstract

An apparatus and a method for processing programs indicated by the associated program description to be audio-only programs, including the following. A respective program description for programs is received. Upon user selection of a program, a determination is made as to whether the selected program is an audio-only program. If the selected program is an audio-only program, then preprogrammed on-screen display information is displayed while the selected audio-only program is played to provide additional visual entertainment for users.

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SYSTEM AND METHOD FOR PROCESSING AUDIO-ONLY PROGRAMS IN A TELEVISION RECEIVER

FIELD OF INVENTION

This invention generally relates to the field of electronic program guide processing and more particularly, to a system and method for processing a program indicated by its program description information to be an audio-only program.

BACKGROUND OF INVENTION

Electronic devices such as televisions and personal computers (PC) require a control system that includes a user interface system. Typically, a user interface provides information to a user and simplifies use of the device. One example of a user interface is an Electronic Program Guide (EPG) in a television system.

An EPG is an interactive, on-screen display feature that displays information analogous to TV listings found in local newspapers or other print media. In addition, an EPG also includes information necessary for collating and decoding programs. An EPG provides information about each program within the time frames covered by the EPG which typically ranges from the next hour up to seven days. The information contained in an EPG includes programming characteristics such as channel number, program title, start time, end time, elapsed time, time remaining, rating (if available), topic, theme, and a brief description of the program's content. EPGs are usually arranged in a two-dimensional table or grid format with time information on one axis and channel information on the other axis.

Unlike non-interactive guides that reside on a dedicated channel and merely scroll through the current programming on the

other channels for the next 2 to 3 hours, EPGs allow viewers to select any channel at any time during some period into the future, e.g., up to seven days forward. Further EPG features include the ability to highlight individual cells of the grid containing program information. Once highlighted, the viewer can perform functions pertaining to that selected program. For instance, the viewer could instantly switch to that program if it is currently being aired. Viewers could also program one touch video cassette recording (VCR) or the like if the television is properly configured and connected to a recording device. Such EPGs are known in the art and described, for instance, in US Pat. Nos. 5,353,121; 5,479,268; and 5,479,266 issued to Young et al. and assigned to StarSight Telecast, Inc.

In addition, US Pat. No. 5,515,106, issued to Chaney et al., and assigned to the same assignee of the present invention, describes in detail an exemplary embodiment including data packet structure necessary to implement an exemplary program guide system. The exemplary data packet structure is designed so that both the channel information (e.g., channel name, call letters, channel number, type, etc.) and the program description information (e.g., content, title, rating, star, etc.) relating to a program may be transmitted from a program guide database provider to a receiving apparatus efficiently.

Also, as discussed in the Chaney patent, it is envisioned that various types of programs will be available to users, including, for example, video and audio program, audio-only program, video-only program or data type program such as an executable computer program or email. In order to uniquely identify the different types of programs mentioned above, a “class” field, for example, is designated in the program guide packet structure to indicate the type of program to be transmitted. The “class” field may be, for example, “audio-

video", "audio", "video" or "data", corresponding respectively to the types of programs described above.

SUMMARY OF THE INVENTION

Therefore, the present inventors recognize that it is desirable to be able to process each type of programs differently depending on the associated program description received in the program guide information. In particular, the present inventors recognize that it is advantageous to provide animated, preprogrammed on-screen display messages on a screen, so that a user may be better entertained visually when an audio-only program is played.

Hence, in accordance with aspects of the present invention, an apparatus is provided in which a respective program description for programs is processed, comprising:

memory means for storing on-screen display information;

user control means for selecting one of said programs;

on-screen display means for displaying said on-screen display information; and

control means for determining from said respective program description whether said selected program is an audio-only program; and for causing said on-screen display means to display said on-screen display information while said audio-only program is played, if said selected program is an audio-only program.

Also, a method for processing a program is provided, comprising the steps of:

storing on-screen display information;

receiving a respective program description for said program;

determining from said respective program description whether said program is an audio-only program; and

displaying said on-screen display information while playing said audio-only program, if said selected program is an audio-only program.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 2. shows an example of a digital video processing apparatus suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 3 shows a block diagram of a specific implementation of a digital satellite system suitable for processing audio-only programs and associated program description information in accordance with the present invention.

Fig. 4 shows an example of a program guide being displayed.

Fig. 5 shows a flowchart, in accordance with the present invention for processing user inputs and audio-only programs according to the present invention.

Fig. 6 shows an example of an animation screen.

DETAILED DESCRIPTION

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs

and associated program guide information in accordance with the present invention. The television receiver shown in Fig. 1 is capable of processing both analog NTSC television signals and internet information. The system shown in FIG. 1 has a first input 1100 for receiving television signal RF_IN at RF frequencies and a second input 1102 for receiving baseband television signal VIDEO IN. Signal RF_IN may be supplied from a source such as an antenna or cable system while signal VIDEO IN may be supplied, for example, by a video cassette recorder (VCR). Tuner 1105 and IF processor 1130 operate in a conventional manner for tuning and demodulating a particular television signal that is included in signal RF_IN. IF processor 1130 produces baseband video signal VIDEO representing the video program portion of the tuned television signal. IF processor 1130 also produces a baseband audio signal that is coupled to an audio processing section (not shown in FIG. 1) for further audio processing. Although FIG. 1 shows input 1102 as a baseband signal, the television receiver could include a second tuner and IF processor similar to units 1105 and 1130 for producing a second baseband video signal from either signal RF_IN or from a second RF signal source.

The system shown in FIG. 1 also includes a main microprocessor (mP) 1110 for controlling components of the television receiver such as tuner 1105, picture-in-picture processing unit 1140, video signal processor 1155, and StarSight® data processing module 1160. As used herein, the term "microprocessor" represents various devices including, but not limited to, microprocessors, microcomputers, microcontrollers and controllers. Microprocessor 1110 controls the system by sending and receiving both commands and data via serial data bus I^2C BUS which utilizes the well-known I^2C serial data bus protocol. More specifically,

central processing unit (CPU) 1112 within mP 1110 executes control programs contained within memory, such as EEPROM 1127 shown in FIG. 1, in response to commands provided by a user, e.g., via IR remote control 1125 and IR receiver 1122. For example, activation of a "CHANNEL UP" feature on remote control 1125 causes CPU 1112 to send a "change channel" command along with channel data to tuner 1105 via I^2C BUS. As a result, tuner 1105 tunes the next channel in the channel scan list. Another example of a control program stored in EEPROM 1127 is software for implementing the operations shown in Fig. 5 to be discussed below and in accordance with the present invention.

Main microprocessor 1110 also controls the operation of a communications interface unit 1113 for providing the capability to upload and download information to and from the internet. Communication interface unit 1113 includes, for example, a modem for connecting to an internet service provider, e.g., via a telephone line or via a cable television line. The communication capability allows the system shown in Figure 1 to provide email capability and internet related features such as web browsing in addition to receiving television programming.

CPU 1112 controls functions included within mP 1110 via bus 1119 within mP 1110. In particular, CPU 1112 controls auxiliary data processor 1115 and on-screen display (OSD) processor 1117. Auxiliary data processor 1115 extracts auxiliary data such as StarSight® data from video signal PIPV.

StarSight® data which provides program guide data information in a known format is typically received only on a particular television channel and the television receiver must tune that channel to extract StarSight® data. To prevent StarSight® data

extraction from interfering with normal use of the television receiver, CPU 1112 initiates StarSight® data extraction by tuning the particular channel only during a time period when the television receiver is usually not in use (e.g., 2:00 AM). At that time, CPU 1112 configures decoder 1115 such that auxiliary data is extracted from horizontal line intervals such as line 16 that are used for StarSight® data. CPU 1112 controls the transfer of extracted StarSight® data from decoder 1115 via I^2C BUS to StarSight® module 1160. A processor internal to the module formats and stores the data in memory within the module. In response to the StarSight® EPG display being activated (e.g., a user activating a particular key on remote control 125), CPU 1112 transfers formatted StarSight® EPG display data from StarSight® module 1160 via I^2C BUS to OSD processor 1117.

OSD processor 1117 operates in a conventional manner to produce R, G, and B video signals OSD_RGB that, when coupled to a displayed device (not shown), will produce a displayed image representing on-screen display information such as on-screen graphics and/or text in according to a flow chart shown in Fig. 5 and to be described later. OSD processor 1117 also produces control signal Fast-Switch (FSW) which is intended to control a fast switch for inserting signals OSD_RGB into the system's video output signal at times when an on-screen display is to be displayed. Therefore, when a user enables the animation feature of the present invention to be described later, OSD processor 1117 produces the corresponding signals OSD_RGB representing the on-screen display information previously stored or programmed in the memory 1127. For example, when a user enables an EPG, e.g., by activating a particular switch on remote control 1125, CPU 1112 enables processor 1117. In response, processor 1117 produces signals OSD_RGB representing the program

guide data information previously extracted and already stored in memory, as discussed above. Processor 1117 also produces signal FSW indicating when the EPG is to be displayed.

Video signal processor (VSP) 1155 performs conventional video signal processing functions, such as luma and chroma processing. Output signals produced by VSP 1155 are suitable for coupling to a display device, e.g., a kinescope or LCD device (not shown in FIG. 1), for producing a displayed image. VSP 1155 also includes a fast switch for coupling signals produced by OSD processor 1117 to the output video signal path at times when graphics and/or text is to be included in the displayed image. The fast switch is controlled by control signal FSW which is generated by OSD processor 1117 in main microprocessor 1110 at times when text and/or graphics are to be displayed.

The input signal for VSP 1155 is signal PIPV that is output by picture-in-picture (PIP) processor 1140. When a user activates PIP mode, signal PIPV represents a large picture (large pix) into which a small picture (small pix) is inset. When PIP mode is inactive, signal PIPV represents just the large pix, i.e., no small pix signal is included in signal PIPV. PIP processor 1140 provides the described functionality in a conventional manner using features included in unit 1140 such as a video switch, analog-to-digital converter (ADC), RAM, and digital to analog converter (DAC).

As mentioned above, the display data included in the EPG display is produced by OSD processor 1117 and included in the output signal by VSP 1155 in response to fast switch signal FSW. When controller 1110 detects activation of the EPG display, e.g., when a user presses an appropriate key on remote control 1125, controller 1110 causes OSD processor 1117 to produce the EPG display using

information such as program guide data from StarSight® module 1160. Controller 1110 causes VSP 1155 to combine the EPG display data from OSD processor 1117 and the video image signal in response to signal FSW to produce a display including EPG. The EPG can occupy all or only a portion of the display area.

When the EPG display is active, controller 1110 executes a control program stored in EEPROM 1127. The control program monitors the location of a position indicator, such as a cursor and/or highlighting, in the EPG display. A user controls the location of the position indicator using direction and selection keys of remote control 1125. Alternatively, the system could include a mouse device. Controller 1110 detects activation of a selection device, such as clicking a mouse button, and evaluates current cursor location information in conjunction with EPG data being displayed to determine the function desired, e.g., tuning a particular program. Controller 1110 subsequently activates the control action associated with the selected feature.

An exemplary embodiment of the features of the system shown in FIG. 1 that have been described thus far comprises an ST9296 microprocessor produced by SGS-Thomson Microelectronics for providing the features associated with mP 1110; an M65616 picture-in-picture processor produced by Mitsubishi for providing the described basic PIP functionality associated with PIP processor 1140; and an LA7612 video signal processor produced by Sanyo for providing the functions of VSP 1155.

Fig. 2 shows another example of an electronic device capable of processing various types of programs including audio-only programs and the associated program guide in accordance with the present invention. As described below, the system shown in Figure 2

is an MPEG compatible system for receiving MPEG encoded transport streams representing broadcast programs. However, the system shown in Figure 2 is exemplary only. User interface systems are also applicable to other types of digital signal processing devices including non-MPEG compatible systems, involving other types of encoded datastreams. For example, other devices include digital video disc (DVD) systems and MPEG program streams, and systems combining computer and television functions such as the so-called "PCTV". Further, although the system described below is described as processing broadcast programs, this is exemplary only. The term 'program' is used to represent any form of packetized data such as telephone messages, computer programs, internet data or other communications, for example.

In overview, in the video receiver system of Figure 2, a carrier modulated with video data is received by antenna 10 and processed by unit 15. The resultant digital output signal is demodulated by demodulator 20 and decoded by decoder 30. The output from decoder 30 is processed by transport system 25 which is responsive to commands from remote control unit 125. System 25 provides compressed data outputs for storage, further decoding, or communication to other devices.

Video and audio decoders 85 and 80 respectively, decode the compressed data from system 25 to provide outputs for display. Data port 75 provides an interface for communication of the compressed data from system 25 to other devices such as a computer or High Definition Television (HDTV) receiver, for example. Storage device 90 stores the compressed data from system 25 on storage medium 105. Device 90, in a playback mode also supports retrieval of the compressed data from storage medium 105 for processing by

system 25 for decoding, communication to other devices or storage on a different storage medium (not shown to simplify drawing).

Considering Figure 2 in detail, a carrier modulated with video data received by antenna 10, is converted to digital form and processed by input processor 15. Processor 15 includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input video signal to a lower frequency band suitable for further processing. The resultant digital output signal is demodulated by demodulator 20 and decoded by decoder 30. The output from decoder 30 is further processed by transport system 25.

Multiplexer (mux) 37 of service detector 33 is provided, via selector 35, with either the output from decoder 30, or the decoder 30 output further processed by a descrambling unit 40. Descrambling unit 40 may be, for example, a removable unit such as a smart card in accordance with ISO 7816 and NRSS (National Renewable Security Standards) Committee standards (the NRSS removable conditional access system is defined in EIA Draft Document IS-679, Project PN-3639). Selector 35 detects the presence of an insertable, compatible, descrambling card and provides the output of unit 40 to mux 37 only if the card is currently inserted in the video receiver unit. Otherwise selector 35 provides the output from decoder 30 to mux 37. The presence of the insertable card permits unit 40 to descramble additional premium program channels, for example, and provide additional program services to a viewer. It should be noted that in the preferred embodiment NRSS unit 40 and smart card unit 130 (smart card unit 130 is discussed later) share the same system 25 interface such that only either an NRSS card or a smart card may be inserted at any one time. However, the interfaces may also be separate to allow parallel operation.

The data provided to mux 37 from selector 35 is in the form of an MPEG compliant packetized transport datastream as defined in MPEG systems standard section 2.4 and includes program guide information and the data content of one or more program channels. The individual packets that comprise particular program channels are identified by Packet Identifiers (PIDs). The transport stream contains Program Specific Information (PSI) for use in identifying the PIDs and assembling individual data packets to recover the content of all the program channels that comprise the packetized datastream. Transport system 25, under the control of the system controller 115, acquires and collates program guide information from the input transport stream, storage device 90 or an internet service provider via the communication interface unit 116. The individual packets that comprise either particular program channel content or Program Guide information, are identified by their Packet Identifiers (PIDs) contained within header information. As discussed above, the program description contained in the program guide information may comprise different program descriptive fields such as title, star, rating, etc., relating to a program.

The user interface incorporated in the video receiver shown in Figure 2 enables a user to activate various features by selecting a desired feature from an on-screen display (OSD) menu. The OSD menu may include an electronic program guide (EPG) as described above and other features discussed below.

Data representing information displayed in the OSD menu is generated by system controller 115 in response to stored on-screen display (OSD) information representing text/graphics, stored program guide information, and/or program guide and text/graphics information received via the input signal as described above and in accordance with an exemplary control program to be shown in Fig. 5

and to be discussed below. The software control program in Fig. 5 may be stored, for example, in embedded memory (not shown) of system controller 115.

Using remote control unit 125 (or other selection means such as a mouse) a user can select from the OSD menu items such as a program to be viewed, a program to be stored, the type of storage media and manner of storage. System controller 115 uses the selection information, provided via interface 120, to configure system 25 to select the programs for storage and display and to generate PSI suitable for the selected storage device and media. Controller 115 configures system 25 elements 45, 47, 50, 55, 65 and 95 by setting control register values within these elements via a data bus and by selecting signal paths via muxes 37 and 110 with control signal C.

In response to control signal C, mux 37 selects either, the transport stream from unit 35, or in a playback mode, a datastream retrieved from storage device 90 via store interface 95. In normal, non-playback operation, the data packets comprising the program that the user selected to view are identified by their PIDs by selection unit 45. If an encryption indicator in the header data of the selected program packets indicates the packets are encrypted, unit 45 provides the packets to decryption unit 50. Otherwise unit 45 provides non-encrypted packets to transport decoder 55. Similarly, the data packets comprising the programs that the user selected for storage are identified by their PIDs by selection unit 47. Unit 47 provides encrypted packets to decryption unit 50 or non-encrypted packets to mux 110 based on the packet header encryption indicator information.

The functions of decryptors 40 and 50 may be implemented in a single removable smart card which is compatible with the NRSS standard. This approach places all security related

functions in one removable unit that can easily be replaced if a service provider decides to change encryption technique or to permit easily changing the security system, e.g., to descramble a different service.

Units 45 and 47 employ PID detection filters that match the PIDs of incoming packets provided by mux 37 with PID values pre-loaded in control registers within units 45 and 47 by controller 115. The pre-loaded PIDs are used in units 47 and 45 to identify the data packets that are to be stored and the data packets that are to be decoded for use in providing a video image. The pre-loaded PIDs are stored in look-up tables in units 45 and 47. The PID look-up tables are memory mapped to encryption key tables in units 45 and 47 that associate encryption keys with each pre-loaded PID. The memory mapped PID and encryption key look-up tables permit units 45 and 47 to match encrypted packets containing a pre-loaded PID with associated encryption keys that permit their decryption. Non-encrypted packets do not have associated encryption keys. Units 45 and 47 provide both identified packets and their associated encryption keys to decryptor 50. The PID look-up table in unit 45 is also memory mapped to a destination table that matches packets containing pre-loaded PIDs with corresponding destination buffer locations in packet buffer 60. The encryption keys and destination buffer location addresses associated with the programs selected by a user for viewing or storage are pre-loaded into units 45 and 47 along with the assigned PIDs by controller 115. The encryption keys are generated by ISO 7816-3 compliant smart card system 130 from encryption codes extracted from the input datastream. The generation of the encryption keys is subject to customer entitlement determined from coded information in the input data stream and/or pre-stored on the insertable smart card itself (International

Standards Organization document ISO 7816-3 of 1989 defines the interface and signal structures for a smart card system).

The packets provided by units 45 and 47 to unit 50 are encrypted using an encryption technique such as the Data Encryption Standard (DES) defined in Federal Information Standards (FIPS) Publications 46, 74 and 81 provided by the National Technical Information Service, Department of Commerce. Unit 50 decrypts the encrypted packets using corresponding encryption keys provided by units 45 and 47 by applying decryption techniques appropriate for the selected encryption algorithm. The decrypted packets from unit 50 and the non-encrypted packets from unit 45 that comprise the program for display are provided to decoder 55. The decrypted packets from unit 50 and the non-encrypted packets from unit 47 that comprise the program for storage are provided to mux 110.

Unit 60 contains four packet buffers accessible by controller 115. One of the buffers is assigned to hold data destined for use by controller 115 and the other three buffers are assigned to hold packets that are destined for use by application devices 75, 80 and 85. Access to the packets stored in the four buffers within unit 60 by both controller 115 and by application interface 70 is controlled by buffer control unit 65. Unit 45 provides a destination flag to unit 65 for each packet identified by unit 45 for decoding. The flags indicate the individual unit 60 destination locations for the identified packets and are stored by control unit 65 in an internal memory table. Control unit 65 determines a series of read and write pointers associated with packets stored in buffer 60 based on the First-In-First-Out (FIFO) principle. The write pointers in conjunction with the destination flags permit sequential storage of an identified packet from units 45 or 50 in the next empty location within the appropriate destination buffer in unit 60. The read pointers permit

sequential reading of packets from the appropriate unit 60 destination buffers by controller 115 and application interface 70.

The non-encrypted and decrypted packets provided by units 45 and 50 to decoder 55 contain a transport header as defined by section 2.4.3.2 of the MPEG systems standard. Decoder 55 determines from the transport header whether the non-encrypted and decrypted packets contain an adaptation field (per the MPEG systems standard). The adaptation field contains timing information including, for example, Program Clock References (PCRs) that permit synchronization and decoding of content packets. Upon detection of a timing information packet, that is a packet containing an adaptation field, decoder 55 signals controller 115, via an interrupt mechanism by setting a system interrupt, that the packet has been received. In addition, decoder 55 changes the timing packet destination flag in unit 65 and provides the packet to unit 60. By changing the unit 65 destination flag, unit 65 diverts the timing information packet provided by decoder 55 to the unit 60 buffer location assigned to hold data for use by controller 115, instead of an application buffer location.

Upon receiving the system interrupt set by decoder 55, controller 115 reads the timing information and PCR value and stores it in internal memory. PCR values of successive timing information packets are used by controller 115 to adjust the system 25 master clock (27 MHz). The difference between PCR based and master clock based estimates of the time interval between the receipt of successive timing packets, generated by controller 115, is used to adjust the system 25 master clock. Controller 115 achieves this by applying the derived time estimate difference to adjust the input control voltage of a voltage controlled oscillator used to generate the master clock.

Controller 115 resets the system interrupt after storing the timing information in internal memory.

Packets received by decoder 55 from units 45 and 50 that contain program content including audio, video, caption, and other information, are directed by unit 65 from decoder 55 to the designated application device buffers in packet buffer 60. Application control unit 70 sequentially retrieves the audio, video, caption and other data from the designated buffers in buffer 60 and provides the data to corresponding application devices 75, 80 and 85. The application devices comprise audio and video decoders 80 and 85 and high speed data port 75. For example, packet data are processed according to the type of program in accordance to a flow chart shown in Fig. 5 to be discussed later. Also, packet data corresponding to a composite program guide generated by the controller 115 as described above, may be transported to the video decoder 85 for formatting into video signal suitable for display on a monitor (not shown) connected to the video decoder 85. Also, for example, data port 75 may be used to provide high speed data such as computer programs, for example, to a computer. Alternatively, port 75 may be used to output data to an HDTV decoder to display images corresponding to a selected program or a program guide, for example.

Packets that contain PSI information are recognized by unit 45 as destined for the controller 115 buffer in unit 60. The PSI packets are directed to this buffer by unit 65 via units 45, 50 and 55 in a similar manner to that described for packets containing program content. Controller 115 reads the PSI from unit 60 and stores it in internal memory.

Controller 115 also generates condensed PSI (CPSI) from the stored PSI and incorporates the CPSI in a packetized datastream suitable for storage on a selectable storage medium. The packet

identification and direction is governed by controller 115 in conjunction with the unit 45 and unit 47 PID, destination and encryption key look-up tables and control unit 65 functions in the manner previously described.

In addition, controller 115 is coupled to a communication interface unit 116 that operates in a manner similar to interface unit 1113 in Figure 1. That is, unit 116 provides the capability to upload and download information to and from the internet. Communication interface unit 116 includes, for example, a modem for connecting to an internet service provider, e.g., via a telephone line or via a cable television line. The communication capability allows the system shown in Figure 2 to provide email capability and internet related features such as web browsing in addition to receiving television programming.

Fig. 3 is a specific implementation of an electronic device generally shown in Fig. 2 and described in detail above. Fig. 3 represents a satellite receiver set-top box, designed and manufactured by Thomson Consumer Electronics, of Indianapolis, Indiana, USA, for receiving DirecTV™ satellite service provided by Hughes Electronics.

As shown in Fig. 3, the set-top box has a tuner 301 which receives and tunes applicable satellite RF signals in the range of 950-1450 Mhz from a satellite antenna 317. The tuned analog signals are outputted to a link module 302 for further processing. Link module 302 is responsible for further processing of the analog tuned signals I_out and Q_out from tuner 301, including filtering and conditioning of the analog signals, and conversion of the analog signals into a digital output signal, DATA. The link module 302 is implemented as an integrated circuit (IC). The link module IC is manufactured by

SGS-Thomson Microelectronics of Grenoble, France, and has Part No. ST 15339-610.

The digital output, DATA, from the link module 302 consists of compliant packetized data stream recognized and processable by the transport unit 303. The datastream, as discussed in detail in relation to Fig. 2, includes program guide data information and the data content of one or more program channels of the satellite broadcast service from DirecTV™. As discussed above, program guide data contains information relating to the what type of program (e.g., audio-only, video-only, etc) as indicated, for example, by the "class" type.

The function of the transport unit 303 is the same as the transport system 25 shown in Fig. 2 and discussed already. As described above, the transport unit 303, processes the packetized datastream according to the Packet Identifiers (PID) contained in the header information. The processed datastream are then formatted into MPEG compatible, compressed audio and video packets and coupled to a MPEG decoder 304 for further processing.

The transport unit 303 is controlled by an Advanced RISC Microprocessor (ARM) 315 which is a RISC based microprocessor. The ARM processor 315 executes control software residing in ROM 308. One component of the software may be, for example, a control program shown in Fig. 5 for processing programs according to their program type in accordance with aspects of the present invention as will be discussed below.

The transport unit 303 may be implemented as an integrated circuit. For example, a preferred embodiment of the transport unit is an IC manufactured by SGS-Thomson Microelectronics having Part No. ST 15273-810 or 15103-65C.

The MPEG compatible, compressed audio and video packets from the transport unit 303 are delivered to a MPEG decoder 304. The MPEG decoder decodes the compressed MPEG datastream from the transport unit 303. The decoder 304 then outputs the applicable audio stream which can be further processed by the audio digital-to-analog converter (DAC) 305 to convert the digital audio data into analog sound. The decoder 304 also outputs applicable digital video data which represents image pixel information to a NTSC encoder 306. The NTSC encoder 306 then further processes this video data into NTSC compatible analog video signal so that video images may be displayed on a regular NTSC television screen. An example of a preferred embodiment of the MPEG decoder is an IC manufactured by SGS-Thomson Microelectronics having Part No. ST I3520.

Included in the MPEG IC 304 is an OSD processor 320. The OSD processor 320 reads data form SDRAM 316 which contains stored OSD information. OSD information corresponds to bitmap OSD graphics/text images. The OSD processor 320 is capable of varying the color of each pixel of an OSD image under the control of the ARM microprocessor 315 in a conventional manner.

The OSD processor 320 is also responsible for generating an exemplary program guide as shown in Fig. 4 under the control of the ARM processor 315. In our exemplary embodiment, upon detecting a user request to generate a guide display, the ARM microprocessor 315 processes the program guide data information obtained from a data stream provided by a program guide information provider and formats the guide data information into OSD pixel data corresponding to a full "grid guide" as shown in Fig. 4. The OSD pixel data from the transport unit 303 is then forwarded to OSD

processor 320 in the MPEG audio/video decoder 304 for generating the guide image, as described before.

As shown in Fig. 4, the "grid guide" 400 typically occupies the whole screen of a display. The grid guide 400 shows a program schedule in a time-and-channel format, similar to a TV schedule listed in a newspaper. In particular, one dimension (e.g., horizontal) of the guide shows the time information while the other dimension (e.g., vertical) of the guide shows the channel information. The time information is conveyed to the user by having a time line 401 on the top portion of the guide and is demarked by half hour intervals. The channel information is conveyed to the user by channel numbers 410 - 416 and corresponding channel station names 420 - 426.

In addition, the program guide 400 contains icons Internet 450 and Email 460. By clicking on these icons, a user can surf the internet and send/receive email respectively through the communication interface unit 307. In addition, an internet web site icon may also be incorporated into a grid of a program guide. For example, by clicking on "ESPN.com" within grid 470, the user will automatically be linked to, for example, an ESPN web site.

Additional relevant functional blocks of Fig. 3 includes modem 307 which corresponds to the communication interface unit 116 shown in Fig. 2 for access to the internet, for example. Conditional Access Module (CAM) 309, corresponds to the NRSS decryption unit 130 shown in Fig. 2 for providing conditional access information. Wideband data module 310 corresponds to High Speed Data Port 75 shown in Fig. 2 for providing high speed data access to, for example, a HDTV decoder or a computer. A keyboard/IR Receiver module 312 corresponds to Remote Unit interface 120 shown in Fig. 2 for receiving user control commands from a user control unit 314.

Digital AV bus module 313 corresponds to I/O port 100 shown in Fig. 2 for connection to an external device such as a VCR or a DVD player.

Figs. 5 shows the flow chart of an exemplary control program which may be executed by either the CPU 1112 of Fig. 1, Controller 115 of Fig. 2, or ARM microprocessor 315 of Fig. 3 to implement the features according to aspects of the present invention. A person skilled in the art would readily recognize that the control program in Fig. 5 when executed by any one of the systems described in Figs. 1-3 will provide the same features in accordance with the present invention. Therefore, to avoid redundancy, the control program shown in Fig. 5 will be described below only with respect to the exemplary hardware implementation shown in Fig. 3.

As shown at step 510 and as discussed above, on-screen display information representing graphics/text images to be displayed according to aspects of the present invention is typically preprogrammed and already stored in, for example, the SDRAM 316. The system shown in Fig. 3 also processes and stores program description information contained in the program guide data for each of the programs described in the program guide data, as shown at step 515. In particular, the "class" information which indicates the type (e.g., audio-only, video-only, audio-video, data, etc.) of program, is retrieved and stored in DRAM 316 by ARM processor 315.

At step 520, a user may select a program from the program guide shown in Fig. 4, for example, by highlighting the grid containing the program, using a user control unit 314 of the system shown in Fig.3. As an example, as shown in Fig. 4, the user has selected the program "SONG 1" in grid 430 by highlighting it.

Once a program is selected, the ARM processor 315 will determine if the selected program is an audio-only program as shown at step 525. As described before, the ARM program determines this

by examining the "class" information contained in the program guide data for this selected program. If the ARM processor 315 determines that this program is not an audio-only program, but is for example, a program having simultaneous audio and video information, the ARM processor 315 will then process this program as normal, by simultaneously displaying the received video and playing the received audio portion of the program, as shown at step 530.

On the other hand, if the ARM processor, at step 525, determines that the received program is an audio-only program, the ARM processor 315 will further determine if an animation feature has been previously selected by the user, as shown at step 535. If the ARM processor determines that the user has not preselected the animation feature, the ARM processor will play the received audio program and display only a blank or blue screen, as shown at step 540. If on the other hand, the ARM processor 315 determines that the user has preselected the animation feature and the selected program is an audio-only program, then the ARM processor will proceed to step 545.

At step 545, the ARM processor 315 will instruct the OSD processor 320 to retrieve preprogrammed OSD information for implementing the animation feature according to the present invention from memory 316. The ARM processor 315 will also instruct the OSD processor 320 to display the OSD information on a display 600 as shown in Fig. 6.

The OSD information in our exemplary embodiment corresponds to a screen having a plurality of screen elements 601-606. The screen elements in this case are, for example, a series of paw prints 601-606. The ARM processor will also instruct the OSD processor 320 to display associated program descriptive information contained in the program guide information about this audio-only

program. For example, the program descriptive information about the content, title, artist and class type of this program are displayed on the screen 600 as shown in Fig. 6.

In addition, to achieve an animated effect of the screen elements 606-606 in our embodiment, the ARM processor will change the color scheme of the screen elements 601-606. For example, the ARM processor may instruct the OSD processor 320 to display all the paw prints 601-606 initially in the same color as the background color (e.g., blue). The OSD may then sequentially change the color of each paw print starting from paw print 601 to paw print 606 and so forth. A viewer may then have the visual effect of seeing a paw gradually stepping upward, leaving behind a trial of prints.

In addition, the same on-screen display information used in the animation feature thus described may also be used as a screen saver. For example, the ARM processor 315 may have a timer routine which keeps track of when the last user command is entered via the user control 314. If a certain time (e.g., 3 mins) has passed since the last user entry, the ARM processor will instruct the OSD processor to display the same OSD information used in the animation feature described above to prevent screen burns. This is advantageous since system resources, especially memory resources are conserved by using the same OSD information to achieve both purposes.

It is to be understood that the embodiments and variations shown and described herein are for illustrations only and that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention.

CLAIMS

1. An apparatus for receiving and processing data representing program description for respective one of a plurality of programs, comprising:

memory means for storing on-screen display (OSD) information;

user control means for selecting one of said programs;

control means for determining from said program description whether said selected program is an audio-only program; and for generating a signal representing a display of said on-screen display information while said selected program is played, if said selected program is an audio-only program.

2. The apparatus of claim 1 wherein said data represent electronic program guide information.

3. The apparatus of claim 1 wherein said on-screen display (OSD) information represents a plurality of screen elements.

4. The apparatus of claim 3 wherein said control means generate said signal by varying color scheme of said screen elements to achieve an animated effect.

5. The apparatus of claim 1 wherein said on-screen display information is also screen-saver display information.

6. Apparatus for displaying on-screen display information to achieve an animated effect, comprising:

means for storing said on-screen display information representing a static image having a plurality of screen elements; and

means for displaying said image and for changing color scheme of said screen elements to achieve an animated effect.

7. A method for processing a program, comprising the steps of:

storing on-screen display information;

receiving a respective program description for said program;

determining from said respective program description whether said program is an audio-only program; and

displaying said on-screen display information while playing said selected program, if said selected program is an audio-only program.

8. The method of claim 7 wherein said respective program description is part of program guide information.

9. The method of claim 7 wherein said on-screen display information comprises a plurality of screen elements.

10. The method of claim 9 comprises the step of varying color scheme of said screen elements to achieve an animated effect.

11. The method of claim 7 wherein said on-screen display information is also screen-saver display information.

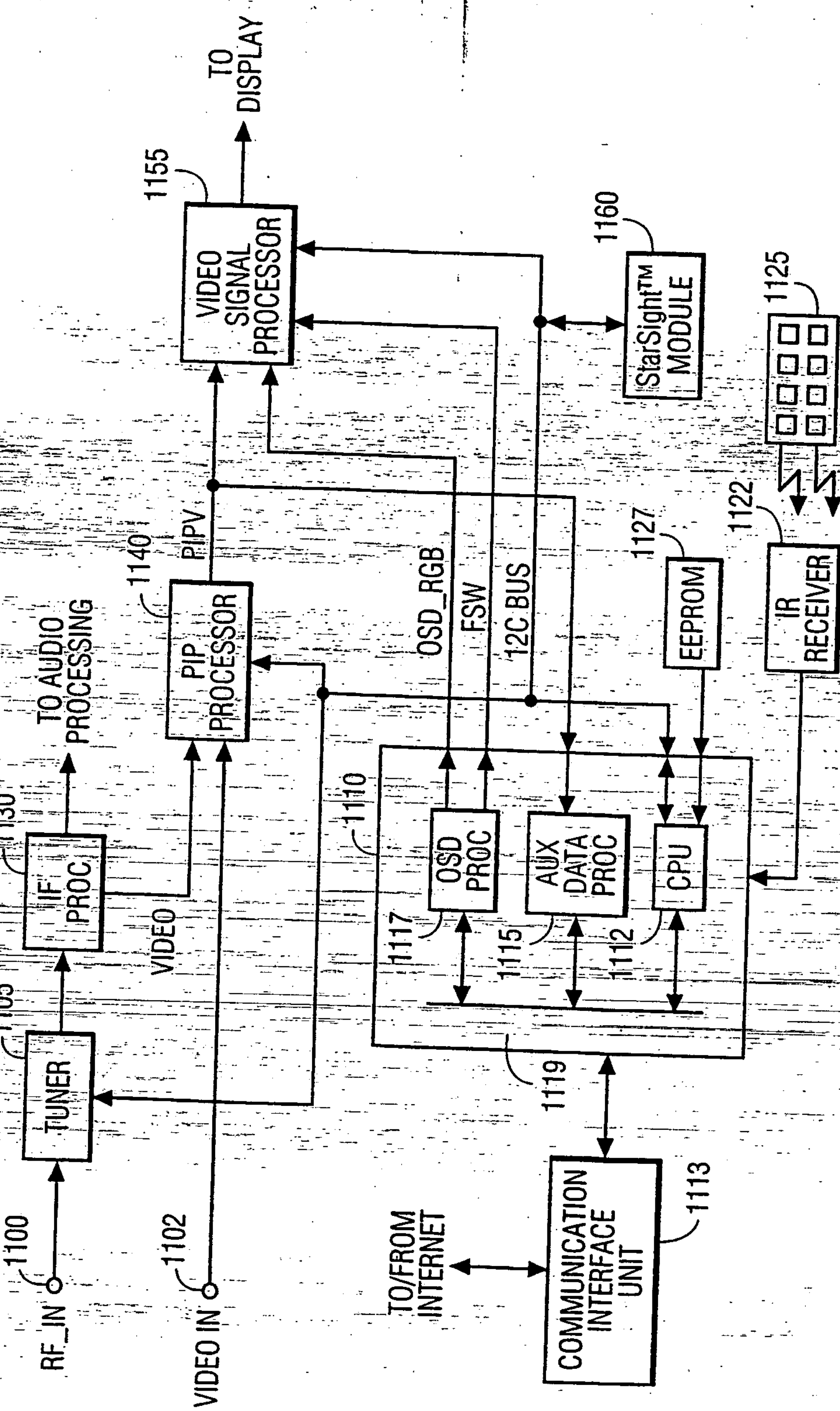
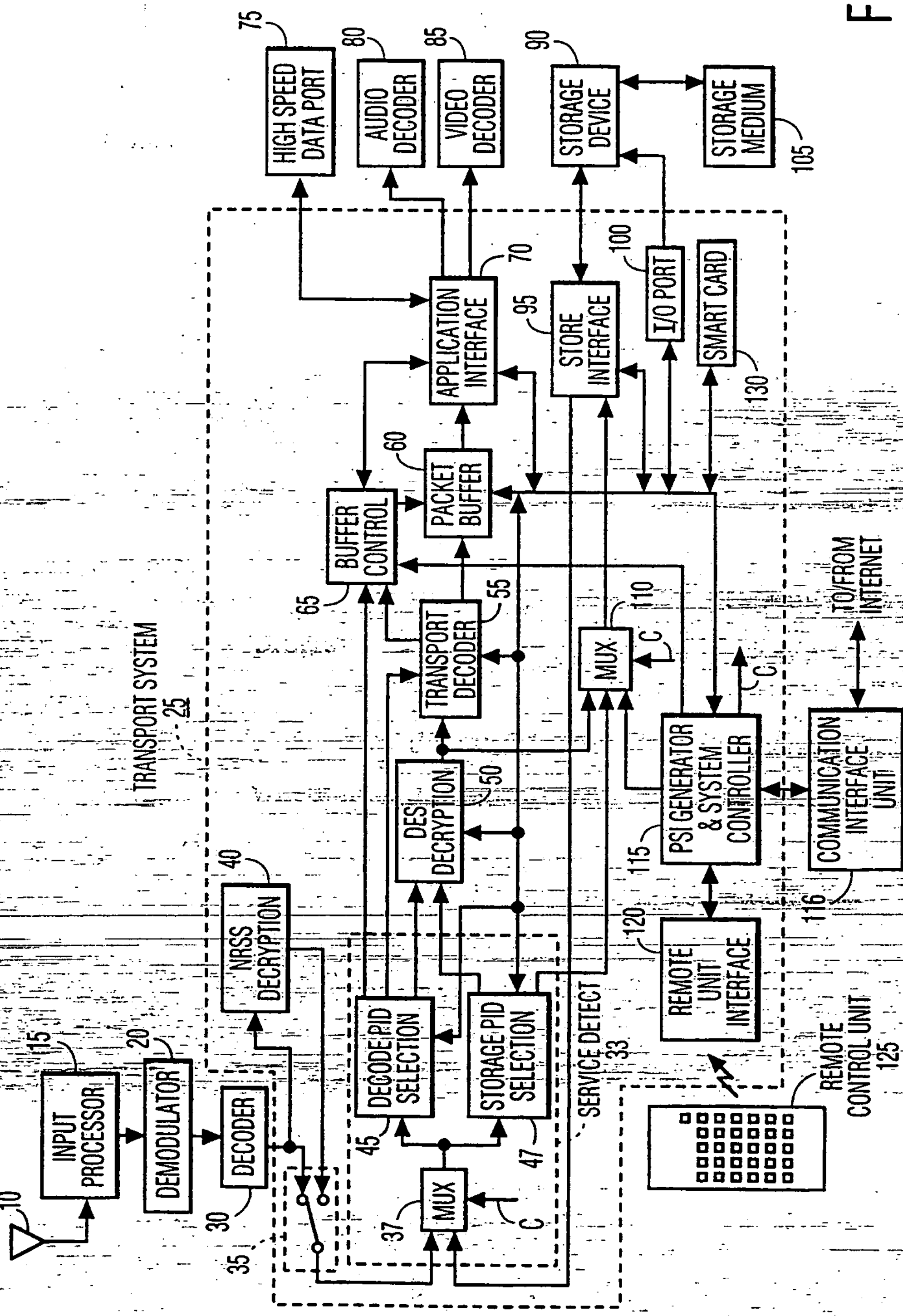

RF_IN
1100
VIDEO IN
1102
TUNER
1105
IF PROC
1130
TO AUDIO PROCESSING
VIDEO
PIP PROCESSOR
1140
PIPV
VIDEO SIGNAL PROCESSOR
1155
TO DISPLAY
OSD_RGB
FSW
12C BUS
StarSight™ MODULE
1160
1125
EEPROM
1127
IR RECEIVER
1122
1110
OSD PROC
1117
AUX DATA PROC
1115
CPU
1112
1119
TO/FROM INTERNET
COMMUNICATION INTERFACE UNIT
1113

FIG. 1

2/6



10
INPUT PROCESSOR
15
DEMODULATOR
20
DECODER
30
35
MUX
37
C
DECODE PID SELECTION
45
STORAGE PID SELECTION
47
SERVICE DETECT 33
NRSS DECRYPTION
40
TRANSPORT SYSTEM 25
DES DECRYPTION
50
TRANSPORT DECODER
55
BUFFER CONTROL
65
PACKET BUFFER
60
APPLICATION INTERFACE
70
HIGH SPEED DATA PORT
75
AUDIO DECODER
80
VIDEO DECODER
85
STORAGE DEVICE
90
STORE INTERFACE
95
I/O PORT
100
STORAGE MEDIUM
105
MUX
110
C
PSI GENERATOR & SYSTEM CONTROLLER
115
C
COMMUNICATION INTERFACE UNIT
116
TO/FROM INTERNET
REMOTE UNIT INTERFACE
120
REMOTE CONTROL UNIT 125
SMART CARD
130

FIG. 2

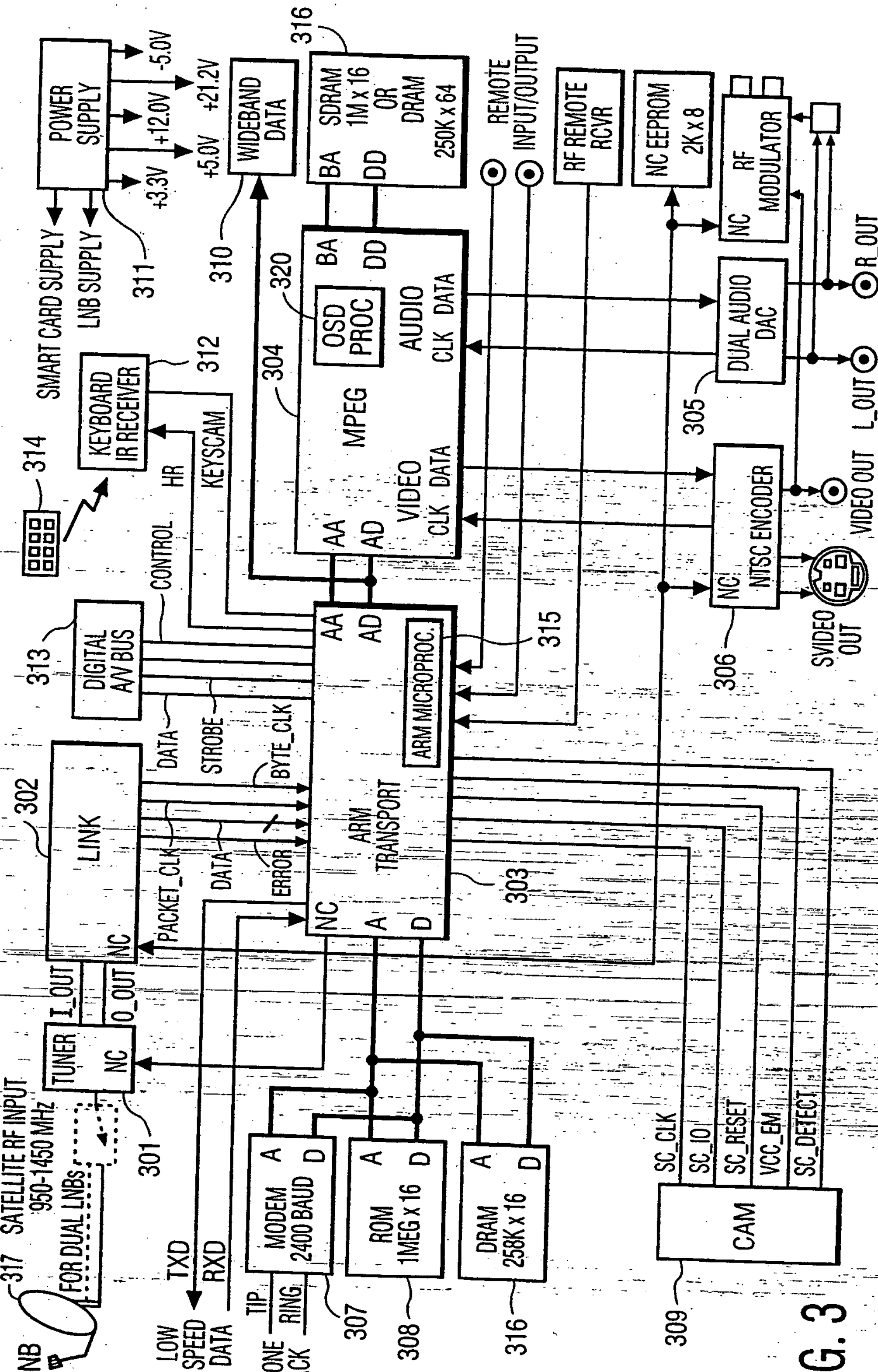

POWER SUPPLY
-5.0V
+21.2V
+12.0V
+5.0V
+3.3V
SMART CARD SUPPLY
LNB SUPPLY
311
WIDEBAND DATA
310
316
SDRAM 1M x 16 OR DRAM 250K x 64
BA
DD
REMOTE INPUT/OUTPUT
RF REMOTE RCVR
NC EEPROM 2K x 8
NC
RF MODULATOR
R_OUT
L_OUT
DUAL AUDIO DAC
305
320
OSD PROC
AUDIO
CLK DATA
MPEG
304
VIDEO
CLK DATA
AA
AD
NTSC ENCODER
VIDEO OUT
SVIDEO OUT
306
314
KEYBOARD IR RECEIVER
312
HR
KEYSCAM
CONTROL
DIGITAL A/V BUS
313
DATA
STROBE
BYTE_CLK
315
ARM MICROPROC.
ARM TRANSPORT
303
LINK
302
PACKET_CLK
DATA
ERROR
NC
A
D
I_OUT
Q_OUT
TUNER
NC
301
SATELLITE RF INPUT 950-1450 MHz
FOR DUAL LNBs
317
LNB
TXD
RXD
LOW SPEED DATA
TIP
RING
PHONE JACK
MODEM 2400 BAUD
307
ROM 1MEG x 16
308
DRAM 258K x 16
316
SC_CLK
SC_IO
SC_RESET
VCC_EM
SC_DETECT
CAM
309

FIG. 3

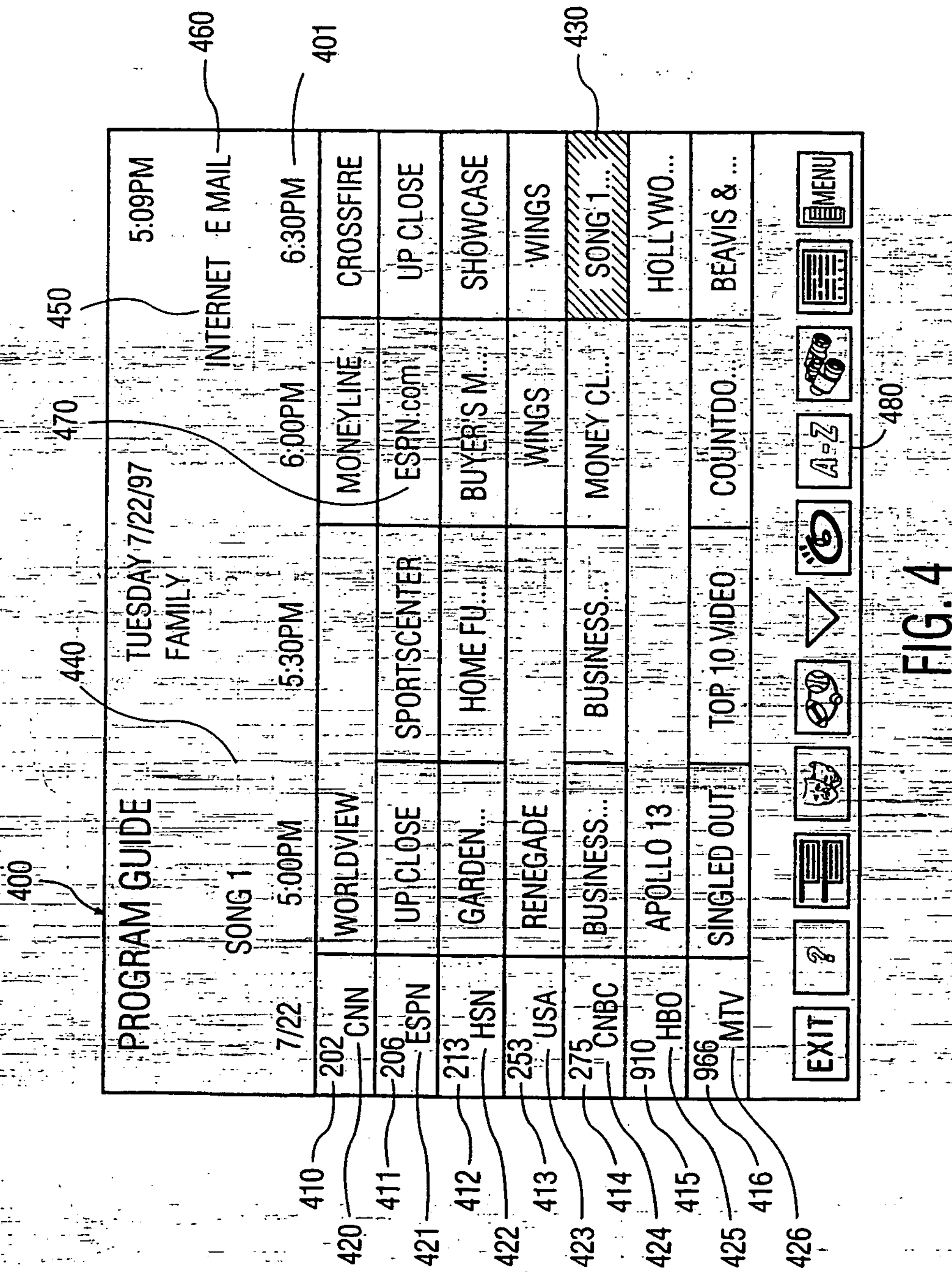

PROGRAM GUIDE
TUESDAY 7/22/97
5:09PM
FAMILY
SONG 1
INTERNET
E MAIL
7/22
5:00PM
5:30PM
6:00PM
6:30PM
202 CNN
206 ESPN
213 HSN
253 USA
275 CNBC
910 HBO
966 MTV
WORLDVIEW
MONEYLINE
CROSSFIRE
UP CLOSE
SPORTSCENTER
ESPN.com
UP CLOSE
GARDEN...
HOME FU...
BUYER'S M...
SHOWCASE
RENEGADE
WINGS
WINGS
BUSINESS...
BUSINESS...
MONEY CL...
SONG 1...
APOLLO 13
HOLLYWO...
SINGLED OUT
TOP 10 VIDEO
COUNTDO...
BEAVIS &...
EXIT
?
A-Z
MENU
400
401
410
411
412
413
414
415
416
420
421
422
423
424
425
426
430
440
450
460
470
480

FIG. 4

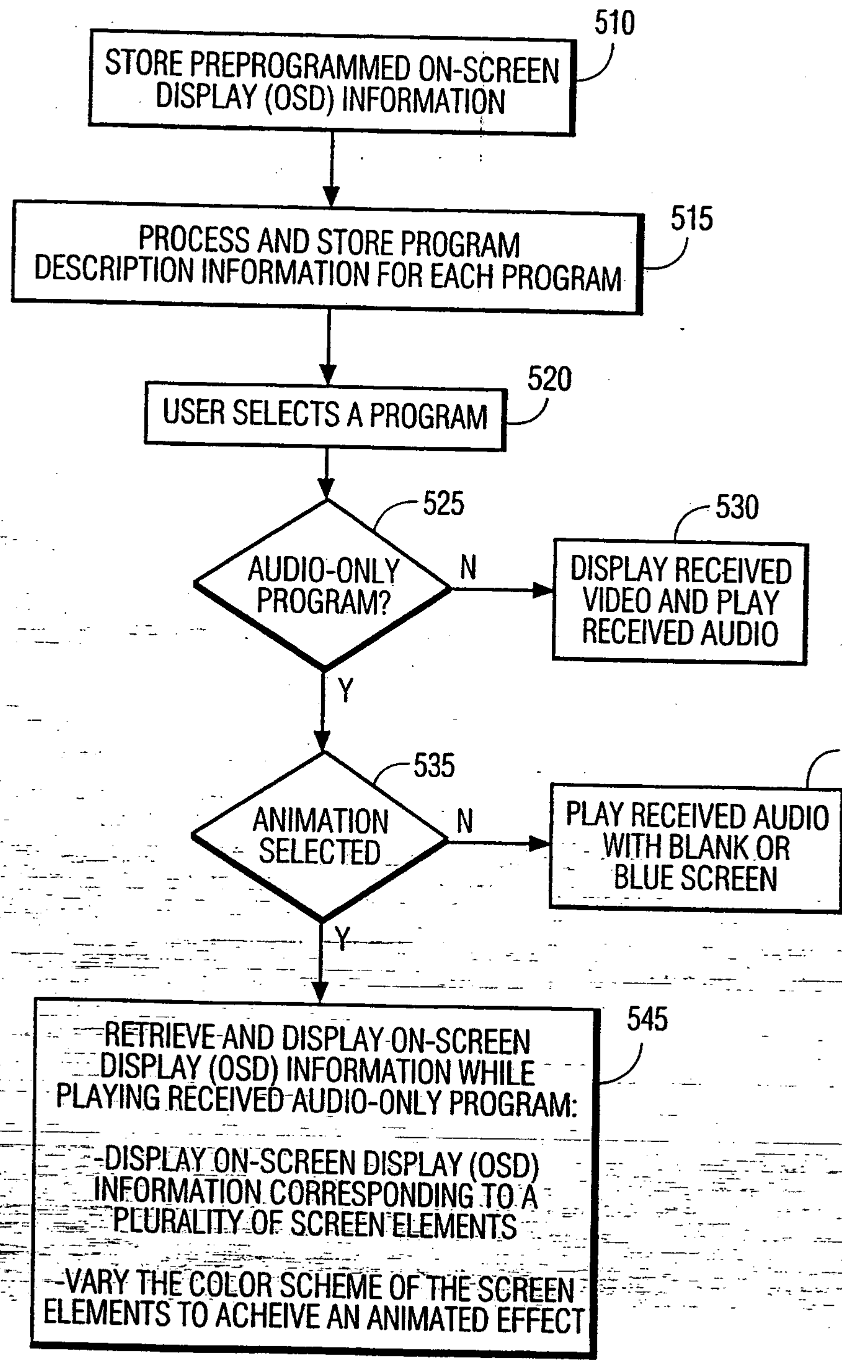

510
STORE PREPROGRAMMED ON-SCREEN DISPLAY (OSD) INFORMATION
515
PROCESS AND STORE PROGRAM DESCRIPTION INFORMATION FOR EACH PROGRAM
520
USER SELECTS A PROGRAM
525
AUDIO-ONLY PROGRAM?
N
530
DISPLAY RECEIVED VIDEO AND PLAY RECEIVED AUDIO
Y
535
ANIMATION SELECTED
N
540
PLAY RECEIVED AUDIO WITH BLANK OR BLUE SCREEN
Y
545
RETRIEVE AND DISPLAY ON-SCREEN DISPLAY (OSD) INFORMATION WHILE PLAYING RECEIVED AUDIO-ONLY PROGRAM:
-DISPLAY ON-SCREEN DISPLAY (OSD) INFORMATION CORRESPONDING TO A PLURALITY OF SCREEN ELEMENTS
-VARY THE COLOR SCHEME OF THE SCREEN ELEMENTS TO ACHEIVE AN ANIMATED EFFECT

FIG. 5

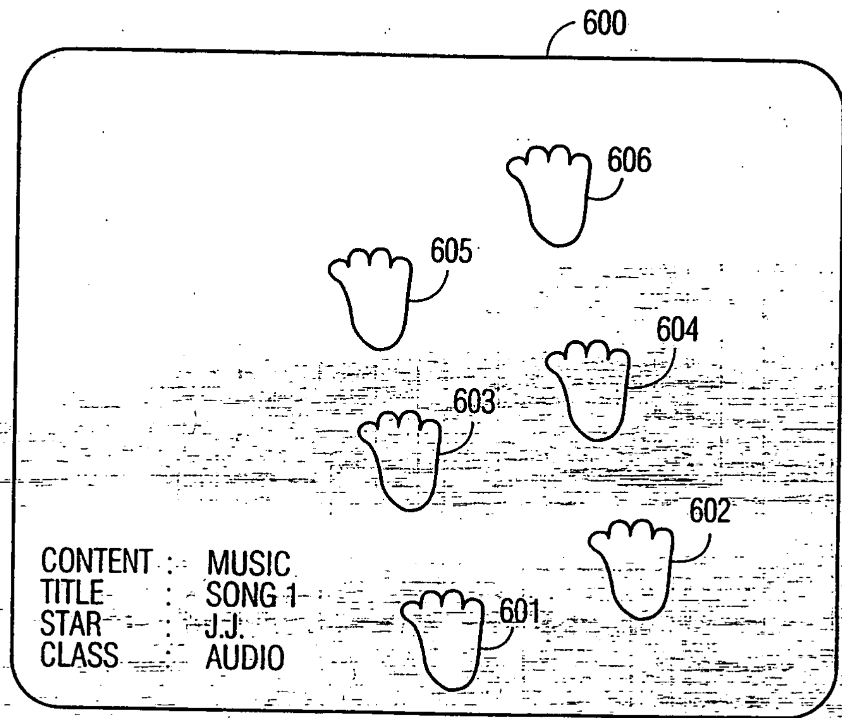

600
606
605
604
603
602
601
CONTENT : MUSIC
TITLE : SONG 1
STAR : J.J.
CLASS : AUDIO

FIG. 6

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Replaced by Article 34

video", "audio", "video" or "data", corresponding respectively to the types of programs described above.

SUMMARY OF THE INVENTION

Therefore, the present inventors recognize that it is desirable to be able to process each type of programs differently depending on the associated program description received in the program guide information. In particular, the present inventors recognize that it is advantageous to provide animated, preprogrammed on-screen display messages on a screen, so that a user may be better entertained visually when an audio-only program is played.

Hence, in accordance with aspects of the present invention, an apparatus is provided in which a respective program description for programs is processed, comprising:

memory means for storing on-screen display information;

user control means for selecting one of said programs;

on-screen display means for displaying said on-screen display information; and

control means for determining from said respective program description whether said selected program is an audio-only program; and for causing said on-screen display means to display said on-screen display information while said audio-only program is played, if said selected program is an audio-only program.

Also, a method for processing a program is provided, comprising the steps of:

storing on-screen display information;

receiving a respective program description for said program;

determining from said respective program description whether said program is an audio-only program; and

displaying said on-screen display information while playing said audio-only program, if said selected program is an audio-only program.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 2. shows an example of a digital video processing apparatus suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 3 shows a block diagram of a specific implementation of a digital satellite system suitable for processing audio-only programs and associated program description information in accordance with the present invention.

Fig. 4 shows an example of a program guide being displayed.

Fig. 5 shows a flowchart, in accordance with the present invention for processing user inputs and audio-only programs according to the present invention.

Fig. 6 shows an example of an animation screen.

DETAILED DESCRIPTION

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs

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418 Rec'd PCT/PTO 03 DEC 1999

CLAIMS

1. An apparatus for receiving and processing data representing program description for respective one of a plurality of programs, comprising:

memory means for storing on-screen display (OSD) information;

user control means for selecting one of said programs;

control means for determining from said program description whether said selected program is an audio-only program; and for generating a signal representing a display of said on-screen display information while said selected program is played, if said selected program is an audio-only program.

2. The apparatus of claim 1 wherein said data represent electronic program guide information.

3. The apparatus of claim 1 wherein said on-screen display (OSD) information represents a plurality of screen elements.

4. The apparatus of claim 3 wherein said control means generate said signal by varying color scheme of said screen elements to achieve an animated effect.

5. The apparatus of claim 1 wherein said on-screen display information is also screen-saver display information.

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6. Apparatus for displaying on-screen display information to achieve an animated effect, comprising:

means for storing said on-screen display information representing a static image having a plurality of screen elements; and

means for displaying said image and for changing color scheme of said screen elements to achieve an animated effect.

7. A method for processing a program, comprising the steps of:

storing on-screen display information;

receiving a respective program description for said program;

determining from said respective program description whether said program is an audio-only program; and

displaying said on-screen display information while playing said selected program, if said selected program is an audio-only program.

8. The method of claim 7 wherein said respective program description is part of program guide information.

9. The method of claim 7 wherein said on-screen display information comprises a plurality of screen elements.

10. The method of claim 9 comprises the step of varying color scheme of said screen elements to achieve an animated effect.

11. The method of claim 7 wherein said on-screen display information is also screen-saver display information.

PATENT COOPERATION TREATY

AUG

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

LIAO F.Y.
TRIPOLI, Joseph, S.
GE & RCA Licensing Management Opera
P.O. Box 5312
Princeton, NJ 08543
ETATS-UNIS D'AMERIQUE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	02.08.99
Applicant's or agent's file reference RCA 89037	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US98/11866	05/06/1998	06/06/1997

Applicant
THOMSON CONSUMER ELECTRONICS, INC. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

   The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

   Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

   For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Bapisch, A Tel.(+49-89) 2399-2262

Form PCT/IPEA/416 (July 1992)

19

PATENT COOPERATION TREATY

REC'D 04 AUG 1999

WIPO PCT

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference RCA 89037	**FOR FURTHER ACTION** See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US98/11866	International filing date *(day/month/year)* 05/06/1998	Priority date *(day/month/year)* 06/06/1997
International Patent Classification (IPC) or national classification and IPC H04N5/445		
Applicant THOMSON CONSUMER ELECTRONICS, INC. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

   I ☒ Basis of the report
   II ☐ Priority
   III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   IV ☐ Lack of unity of invention
   V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   VI ☐ Certain documents cited
   VII ☒ Certain defects in the international application
   VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/12/1998	02.08.99
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Glendinning, D Telephone No. (+49-89) 2399 2443

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I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1,2,5-24	as originally filed			
3,4,4a	as received on	19/07/1999	with letter of	15/07/1999

Claims, No.:

1-16	as received on	19/07/1999	with letter of	15/07/1999

Drawings, sheets:

1/6-6/6	as originally filed

2. The amendments have resulted in the cancellation of:

   ☐ the description, pages:
   ☐ the claims, Nos.:
   ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

   see separate sheet

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-16
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-16
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

I Basis of the Report

The page identified as 4a is that filed as 4/1 by the applicants with their letter of 15.07.99.

V Reasoned statement under Article 35(2)

This invention relates to a method and apparatus for processing programs having both audio and video content and also programs having only audio content. When an audio-only program is selected an animated image is displayed on screen. There is no disclosure or suggestion of such subject matter in the prior art documents cited in the Search Report, so the claimed subject matter is new and has inventive step.

VII Certain defects in the international application

In referring to prior art documents on page 3 the application includes the symbols D1 and/or D2 in lines 3, 4, 8 and 13. D1 and D2 are simply convenient labels used by the examiner in the Written Opinion to avoid the need to repeat the titles of the documents referred to - these labels have no official status whatsoever and should not be used in the application itself.

09/445175

video", "audio", "video" or "data", corresponding respectively to the types of programs described above.

D1, US 5,585,866, discloses a receiver capable of receiving both an audiovisual and an audio-only program. The receiver in D1 is able to play a received audio-only program while displaying non-moving, associated program text data on the receiver's display. Of course, various methods for generating graphics, including animated graphics, on a display are well know in the art. For example, various methods are disclosed in D2, an article by Richard G. Shroup, entitled "Color Table Animation," in the Proc. Of Annual Conference on Computer Graphics and Interact. Tech. (SIGGRAPH '79), 6th; Chicao, IL, USA, Aug. 8-10, 1979., Vol. 13, no.2, Aug. 1979, pages 8-13, XP002075128, Comput. Graphics (ACM) Aug. 1979. However, references D1 and D2, either alone or combined, do not teach or suggest that it is desirable to display pre-stored animated pictures either automatically or in response to a user request, when an audio-only program is activated. The animated picture may serve as additional entertainment to a user and/or function as a screen saver to prevent screen burn.

SUMMARY OF THE INVENTION

Therefore, the present inventors recognize that it is desirable to be able to process each type of programs differently depending on the associated program description received in the program guide information. In particular, the present inventors recognize that it is advantageous to provide animated image on a screen, so that a user may be better entertained visually and/or serve as a screen saver when an audio-only program is played.

Hence, in accordance with aspects of the invention, an apparatus for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

memory means for storing display information representing an animated image;

AMENDED SHEET

control means for determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content; and the control means causes the playing of the audio content and displaying of the video content when the selected program is a first type of program and causes the playing of the audio-only content and displaying of the animated image when the selected program is a second type of program.

Also, a method for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

storing display information representing an animated image;

determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content;

causing the playing of the audio content and displaying of the video content when the selected program is a first type of program; and

causing the playing of the audio-only content and displaying of the animated image when the selected program is a second type of program."

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 2. shows an example of a digital video processing apparatus suitable for processing various types of programs, including audio-only programs and associated program description information in accordance with the present invention.

Fig. 3 shows a block diagram of a specific implementation of a digital satellite system suitable for processing audio-only programs and

associated program description information in accordance with the present invention.

Fig. 4 shows an example of a program guide being displayed.

Fig. 5 shows a flowchart, in accordance with the present invention for processing user inputs and audio-only programs according to the present invention.

Fig. 6 shows an example of an animation screen.

DETAILED DESCRIPTION

Fig. 1 shows an example of a television system suitable for processing various types of programs, including audio-only programs

CLAIMS

1. An apparatus for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

memory means for storing display information representing an animated image;

control means for determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content; and the control means causes the playing of the audio content and displaying of the video content when the selected program is a first type of program and causes the playing of the audio-only content and displaying of the animated image when the selected program is a second type of program.

2. The apparatus of claim 1 wherein the control means determines the type of program based on program guide information received.

3. The apparatus of claim 1 wherein program guide information is displayed along with the animated image.

4. The apparatus of claim 1 wherein the animated image serves as a screen saver.

5. An apparatus for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

memory means for storing display information representing an animated image;

user control means for selecting a first and a second mode;

control means for determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content; and

the control means causes, when the selected program is a first type of program, the playing of the audio content and displaying of the video content; and causes, when the selected program is a second type of program, in the first mode,

the playing of the audio-only content and displaying of the animated image, and in the second mode, the playing of the audio-only content and displaying of a static screen.

6. The apparatus of claim 5 wherein the static screen is a blank screen.

7. The apparatus of claim 5 wherein the static screen is a blue screen.

8. The apparatus of claim 5 wherein the control means determines the type of program based on program guide information received.

9. A method for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

storing display information representing an animated image;

determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content;

causing the playing of the audio content and displaying of the video content when the selected program is a first type of program; and

causing the playing of the audio-only content and displaying of the animated image when the selected program is a second type of program.

10. The method of claim 9 wherein the determining step is based on program guide information received.

11. The method of claim 9 further comprising the step of displaying program guide information along with the animated image.

12. A method for processing a first type of program having both audio and video content and a second type of program having audio-only content, characterized in that:

storing display information representing an animated image;

selecting a first and a second mode;

determining whether a selected program is the first type of program having both audio and video content or the second type of program having audio-only content;

causing, when the selected program is a first type of program, the playing of the audio content and displaying of the video content;

and causing, when the selected program is a second type of program, in the first mode, playing of the audio-only content and displaying of the animated image, and in the second mode, playing of the audio-only content and displaying of a static screen.

13. The method of claim 12 wherein the static screen is a blank screen.

14. The method of claim 12 wherein the static screen is a blue screen.

15. The apparatus of claim 12 wherein the determining step is based on program guide information received.

16. The apparatus of claim 12 wherein the animated image serves as a screen saver.

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ENT COOPERATION TREATY

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
RCA 89037		
International application No.	International filing date (*day/month/year*)	(Earliest) Priority Date (*day/month/year*)
PCT/US 98/11866	05/06/1998	06/06/1997
Applicant		
THOMSON CONSUMER ELECTRONICS, INC. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] **Certain claims were found unsearchable** (see Box I).

2. [X] **Unity of invention is lacking** (see Box II).

3. [ ] The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] Transcribed by this Authority

4. With regard to the **title**,
   - [ ] the text is approved as submitted by the applicant
   - [X] the text has been established by this Authority to read as follows:

   SYSTEM AND METHOD FOR PROCESSING AUDIO-ONLY PROGRAMS IN A TELEVISION RECEIVER

5. With regard to the **abstract**,
   - [X] the text is approved as submitted by the applicant
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

   Figure No. 6
   - [X] as suggested by the applicant.
   - [ ] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US 98/11866

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see continuation sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-5,7-11

Apparatus for displaying preprogrammed on-screen display information when an audio-only program is selected in a television receiver.

2. Claim : 6

Apparatus for displaying on-screen display information to achieve an animated effect.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 98/11866

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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INTERNATIC L SEARCH REPORT

Information on patent family members

Inte ional Application No
PCT/US 98/11866

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
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			EP	0674824	A	04-10-1995
			EP	0822718	A	04-02-1998
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			EP	0856993	A	05-08-1998
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			JP	10505735	T	02-06-1998

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/445 H04N7/088

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 585 866 A (MILLER LARRY ET AL) 17 December 1996 see column 9, line 28 - line 44 see column 30, line 11 - column 31, line 24	1-3,7-9
A	see figures 43-46 ---	4,5,10,11
X	WO 94 13107 A (DISCOVERY COMMUNICAT INC) 9 June 1994 see page 21, line 11 - page 22, line 17 see page 80, line 7 - line 15 see page 82, line 3 - line 11 see page 82, line 19 - page 83, line 13	1-3,7-9
A	see figures 6,8,21 --- -/--	4,5,10,11

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 August 1998	25/09/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Berbain, F

International Application No
PCT/US 98/11866

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

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(71) Applicant: DISCOVERY COMMUNICATIONS, INC. [US/US]; 7700 Wisconsin Avenue, Bethesda, MD 20814-3522 (US).

(72) Inventors: HENDRICKS, John, S.; 8723 Persimmon Tree Road, Potomac, MD 20854 (US). BONNER, Alfred, E.; 8300 Bradley Boulevard, Bethesda, MD 20817 (US). WUNDERLICH, Richard, E.; 290 Sweet Briar Court, Alpharetta, GA 30201 (US). BERKOBIN, Eric, C.; 108 Hillview Court, Woodstock, GA 30188 (US).

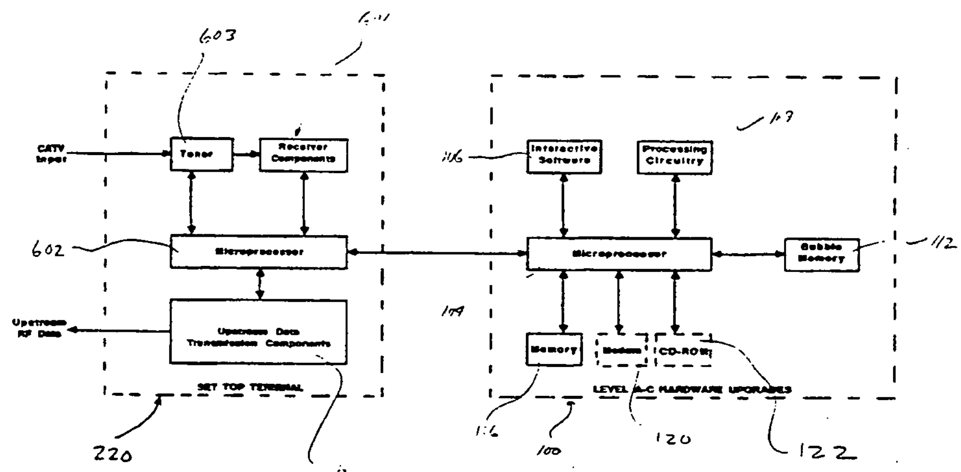
(74) Agents: NOTO, Aldo; Dorsey & Whitney, 1330 Connecticut Avenue, N.W., Suite 200, Washington, DC 20036 (US) et al.

(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ADVANCED SET TOP TERMINAL FOR CABLE TELEVISION DELIVERY SYSTEMS



(57) Abstract

A novel advanced set top terminal capable of digital decompression, menu generation, interactivity and other advanced functional capabilities for use in a television program delivery system (200) is described. The invention relates to methods and apparatus for upgrading existing set top terminals (220) to provide menu generation capability and advanced functional capabilities. The invention is particularly useful in television program delivery systems (200) with hundreds of channels of programming, providing (i) menu driven program selection through the addition of an upgrade module (300) or menu generation card and (ii) advanced functional capabilities using a set of hardware upgrades (e.g. 130) and/or an expansion card. Specifically, the invention is an upgradeable system that supports advanced set top functionality through the use of internal software, hardware upgrades, an upgrade module and/or expansion cards. The upgraded hardware generally includes a microprocessor, various input/ouput ports (e.g., 308), processing circuitry (e.g., 108) and memory (e.g., 116). The invention results in an upgraded set top terminal that supports: menu generation; picture-on-picture displays; program catalogue services; interactive services; telephone caller identification; digital audio reception; VCR control; HDTV reception; and backyard satellite system interoperability, among other features and capabilities.

ADVANCED SET TOP TERMINAL FOR CABLE TELEVISION DELIVERY SYSTEMS

RELATED APPLICATIONS

This application is a continuation-in-part of application Serial Number 07/991,074 filed December 9, 1992 entitled TELEVISION PROGRAM PACKAGING AND DELIVERY SYSTEM WITH MENU DRIVEN SUBSCRIBER ACCESS. The following other continuation-in-part applications, also based on the above-referenced patent application, are incorporated herein by reference:

Ser. No. __________, entitled REPROGRAMMABLE TERMINAL FOR SUGGESTING PROGRAMS OFFERED ON A TELEVISION PROGRAM DELIVERY SYSTEM, filed on December _____, 1993;

Ser. No. __________, entitled NETWORK CONTROLLER FOR CABLE TELEVISION DELIVERY SYSTEMS, filed on December _____, 1993;

Ser. No. __________, entitled AN OPERATIONS CENTER FOR A TELEVISION PROGRAM PACKAGING AND DELIVERY SYSTEM, filed on December _____, 1993;

Ser No. __________, entitled SET TOP TERMINAL FOR CABLE TELEVISION DELIVERY SYSTEMS, filed on December _____, 1993;

Ser. No. __________, entitled DIGITAL CABLE HEADEND FOR CABLE TELEVISION DELIVERY SYSTEM, filed on December _____, 1993.

TECHNICAL FIELD

The invention relates to television entertainment systems for providing television programming to consumer homes. More particularly, the invention relates to a set top terminal for use with a program delivery system with menu selection of programs.

BACKGROUND OF THE INVENTION

Advances in television entertainment have been primarily driven by breakthroughs in technology. In 1939, advances on Vladmir Zworykin's picture tube provided the stimulus for NBC to begin its first regular broadcasts. In 1975, advances in satellite technology provided consumers with increased programming to homes.

Many of these technology breakthroughs have produced inconvenient systems for consumers. One example is the ubiquitous three remote control home, having a separate and unique remote control for the TV, cable box and VCR. More recently, technology has provided cable users in certain parts of the country with 100 channels of programming. This increased program capacity is beyond the ability of many consumers to use effectively. No method of managing the program choices has been provided to consumers.

Consumers are demanding that future advances in television entertainment, particularly programs and program choices, be presented to the consumer in a user friendly manner. Consumer preferences, instead of technological breakthroughs, will drive the television entertainment market for at least the next 20 years. As computer vendors have experienced a switch from marketing new technology in computer hardware to marketing better useability, interfaces and service, the television entertainment industry will also experience a switch from new technology driving the market to consumer useability driving the market.

Consumers want products incorporating new technology that are useful, and will no longer purchase new technology for the sake of novelty or status. Technological advances in sophisticated hardware are beginning to surpass the capability of the average consumer to use the new

technology. Careful engineering must be done to make entertainment products incorporating new technology useful and desired by consumers.

In order for new television entertainment products to be successful, the products must satisfy consumer demands. TV consumers wish to go from limited viewing choices to a variety of choices, from no control of programming to complete control. Consumers wish to advance from cumbersome and inconvenient television to easy and convenient television and keep costs down. Consumers do not wish to pay for one hundred channels when due to lack of programming information, they seldom, if ever, watch programming on many of these channels.

The concepts of interactive television, high definition television and 300 channel cable systems in consumer homes will not sell if they are not packaged, delivered and presented in a useable fashion to consumers. The problem is that TV programming is not being delivered and presented to consumers in a user friendly manner.

Consumers are already being bombarded with programming options, numerous "free" cable channels, subscription cable channels and pay-per-view choices. Any further increase in TV entertainment choices, without a user friendly presentation and approach, will likely bewilder viewers with a mind-numbing array of choices.

The TV industry has traditionally marketed and sold its programs to consumers in bulk, such as continuous feed broadcast and long-term subscriptions to movie channels. The TV industry is unable to sell its programming in large quantities on a unit per unit basis, such as the ordering of one program. Consumers prefer a unit sales approach because it

keeps costs down and allows the consumer to be more selective in their viewing.

In addition, viewership fragmentation, which has already begun, will increase. Programming not presented in a user friendly manner will suffer with a decrease in viewership and revenue. As programming presentation becomes more user friendly, users seek additional features and functional capabilities.

What is needed is a system which can deliver and present television programming through a user friendly interface which allows the consumer to easily select from among the many program choices.

What is needed is a set top converter that provides a user friendly interface for subscribers to access television programs.

What is needed is a set top converter with enhanced functionality.

What is needed is a set top converter that provides users with advanced features and capabilities.

What is needed is a method that allows efficient access to hundreds of television programming options.

What is needed is technology that upgrades the functionality of existing set top converters.

What is needed is hardware that provides an upgrade capability allowing the use of existing set top converter technology in advanced program delivery systems.

What is needed is a set top converter that provides an upstream communications capability between the set top converter and cable headend.

What is needed is a set top converter that provides a capability of generating menus for display.

What is needed is a set top converter that provides a simple way to select a program from a menu.

What is needed is a set top converter that allows users to subscribe on-screen to specialty channels.

What is needed is a set top converter that monitors subscriber viewing choices for statistical purposes.

What is needed is a set top converter that provides sophisticated on-screen television menus which can incorporate still video and moving video.

What is needed is a set top converter that provides a capability of scaling and redirecting video for menus. The present invention is addressed to fulfill these needs.

SUMMARY OF INVENTION

The present invention is a set top converter box or terminal for a television program delivery system. More specifically, the present invention is an advanced set top converter box that acts as a terminal in the viewer home. The set top terminal is a key component of a digital cable television delivery system. The set top terminal is an upgradeable system that provides for the decompression of digital program signals. The preferred set top terminal provides both a menu generation capability as well as a number of advanced features and functional capabilities.

The set top terminal of the present invention may be achieved through a set of hardware upgrades to any of the following embodiments: (1) an existing set top converter upgraded with a circuit card (which has a microprocessor electronically connected to the set top converter); (2) an industry standard decompression converter upgradeable by either an upgrade module or a menu generation card; and (3) a set top converter box capable of both decompression and menu generation. The hardware upgrades provide additional

advanced features and functional capabilities to any of these embodiments.

A number of advanced features and functional capabilities are supported by the preferred set top terminal. This set top terminal provides subscribers with a picture-on-picture capability without requiring a special television to support the capability. The set top terminal also supports a TV guide service, which provides subscribers with information on all programming available at its particular subscriber location. The set top terminal further includes the capability of querying viewers to establish, among other things, favorite channel lists, personal profile data and mood information. The set top terminal allows the subscriber to view promotional menus on future programming events.

The set top terminal supports additional capabilities using its hardware upgrades that allow subscribers to use other interactive services, for example, to engage in on-line question and answer sessions, to order and confirm airline tickets, and to access a variety of other data services. The set top terminal makes use of a digital tuner as a hardware upgrade to provide subscribers with a digital audio capability.

The preferred set top terminal may be used to control video tape machines, thereby simplifying the recording of programs. The set top terminal can, in conjunction with the program delivery system, easily support high definition television (HDTV). For subscribers living in remote locations, the set top terminal accommodates backyard satellite systems. In addition to all the features that the set top terminal supports with its current internal programming and upgradeability, additional features may be added or existing features increased through remote reprogramming of the set top terminal 220.

It is an object of the invention to provide a user friendly interface for subscribers to access television programs.

It is an object of the invention to allow users to easily navigate through hundreds of programming choices using on-screen menus.

It is an object of this invention to efficiently access hundreds of television programming options.

It is an object of this invention to upgrade the functionality of existing set top converters.

It is an object of this invention to provide an upgrade capability allowing the use of existing set top converter technology in an advanced program delivery system.

It is an object of this invention to provide an upstream communications capability between the set top converter and cable headend.

It is an object of this invention to provide a set top terminal capable of generating menus for display.

It is an object of this invention to allow users to subscribe on-screen to specialty channels.

It is an object of this invention to monitor subscriber viewing choices for statistical purposes.

It is an object of this invention to provide sophisticated on-screen television menus which can incorporate still video and moving video.

These and other objects and advantages of the invention will become obvious to those skilled in the art upon review of the following description, the attached drawings and appended claims.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a diagram of the primary components of the television delivery system.

Figure 2 is an overview of the television delivery system operations.

Figure 3 is a schematic of the operation of the primary components of the system.

Figure 4 is a block diagram of the hardware components of the set top terminal.

Figure 5a is a perspective front view of a set top terminal.

Figure 5b is a perspective rear view of a set top terminal.

Figure 6 is a schematic of a Turbo card upgrade for a set top terminal.

Figure 7a is a drawing of a frame format for program control information signal.

Figure 7b is a drawing of a frame format for a polling response from the set top terminal.

Figure 8 is a drawing of the basic menus used in the present invention, including the ten major menus represented by icons.

Figure 9a is a schematic of a basic decompression box with upgrade module and associated connections.

Figure 9b is a schematic of an alternative embodiment of a simple decompression box with upgrade module and associated connections.

Figure 10 is a more detailed block diagram of the components of a simple decompression box with upgrade module.

Figure 11 is a schematic of the set top terminal's upstream data transmission hardware.

Figure 12a is a schematic showing the components of the Level A, B, and C hardware upgrades.

Figure 12b is a schematic showing the components of the Level D hardware upgrade.

Figure 13a is a schematic showing the two parts of a remote control unit.

Figure 13b is a drawing of the preferred remote control unit.

Figure 14 is a diagram of the components of a set top terminal having a picture-on-picture capability.

Figure 15 is a drawing of a menu related to program catalogue services.

Figures 16a through 16d are drawings of viewer querying and mood question menus.

Figures 17a and 17b are drawings of the set top terminal hardware components that accommodate transparent channel switching.

Figure 18 is a drawing of an interactive television promotional menu for a set top terminal hardware upgrade.

Figures 19a and 19b are drawings of submenus for interactive television services using hardware upgrade Level A.

Figures 20a through 20d are drawings of interactive services using hardware upgrade Level B, which are related to on-screen airline reservations.

Figure 21 is a drawing of a menu for digital audio services.

Figure 22 is a drawing of a menu related to program guide services.

Figure 23 is a drawing of a menu related to high definition television (HDTV) programming.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A. Television Program Delivery System Description

1. Introduction

Figure 1 shows the present invention as part of an expanded cable television program delivery system 200 that dramatically increases programming capacity using compressed transmission of television program signals. Developments in digital bandwidth compression technology now allow much greater throughput of television program signals over existing or slightly modified transmission media. The program delivery system 200 shown provides subscribers with a user friendly interface to operate and exploit a six-fold or more increase in current program delivery capability.

Subscribers are able to access an expanded television program package and view selected programs through a menu-driven access scheme that allows each subscriber to select individual programs by sequencing a series of menus. The menus are sequenced by the subscriber using simple alpha-numeric and iconic character access or moving a cursor or highlight bar on the TV screen to access desired programs by simply pressing a single button, rather than recalling from memory and pressing the actual two or more digit numeric number assigned to a selection. Thus, with the press of a single button, the subscriber can advance from one menu to the next. In this fashion, the subscriber can sequence the menus and select a program from any given menu. The programs are grouped by category so that similar program offerings are found on the same menu.

2. Major System Components

In its most basic form, the system uses a program delivery system 200 in conjunction with a conventional

concatenated cable television system 210. The program delivery system 200 generally includes (i) at least one operations center 202, where program packaging and control information are created and then assembled in the form of digital data, (ii) a digital compression system, where the digital data is compressed, combined/multiplexed, encoded, and mapped into digital signals for satellite transmission to the cable headend 208, and (iii) a set of in-home decompressors. The program delivery system 200 transports the digital signals to the cable headend 208 where the signals are transmitted through a concatenated cable television system 210. Within the cable headend 208, the received signals may be decoded, demultiplexed, managed by a local central distribution and switching mechanism, combined and then transmitted to the set top terminal 220 located in each subscriber's home over the cable system 210. Although concatenated cable systems 210 are the most prevalent transmission media to the home, telephone lines, cellular networks, fiberoptics, Personal Communication Networks and similar technology for transmitting to the home can be used interchangeably with this program delivery system 200.

The delivery system 200 has a reception region 207 with an in-home decompression capability. This capability is performed by a decompressor housed within a set top terminal 220 in each subscriber's home. The decompressor remains transparent from the subscriber's point of view and allows any of the compressed signals to be demultiplexed and individually extracted from the composite data stream and then individually decompressed upon selection by the subscriber. The decompressed video signals are converted into analog signals for television display. Such analog signals include NTSC formatted signals for use by a standard

television. Control signals are likewise extracted and decompressed and then either executed immediately or placed in local storage such as a RAM. Multiple sets of decompression hardware may be used to decompress video and control signals. The set top terminal 220 may then overlay or combine different signals to form the desired display on the subscriber's television. Graphics on video or picture-on-picture are examples of such a display.

Although a single digital compression standard (e.g., MPEG) may be used for both the program delivery system 200 and the concatenated cable system 210, the compression technique used may differ between the two systems. When the compression standards differ between the two media, the signals received by the cable headend 208 must be decompressed before transmission from the headend 208 to the set top terminals 220. Subsequently, the cable headend 208 must recompress and transmit the signals to the set top terminal 220, which would then decompress the signals using a specific decompression algorithm.

The video signals and program control signals received by the set top terminal 220 correspond to specific television programs and menu selections that each subscriber may access through a subscriber interface. The subscriber interface is a device with buttons located on the set top terminal 220 or on a portable remote control 900. In the preferred system embodiment, the subscriber interface is a combined alpha-character, numeric and iconic remote control device 900, which provides direct or menu-driven program access. The preferred subscriber interface also contains cursor movement and go buttons as well as alpha, numeric and iconic buttons. This subscriber interface and menu arrangement enables the subscriber to sequence

through menus by choosing from among several menu options that are displayed on the television screen. In addition, a user may bypass several menu screens and immediately choose a program by selecting the appropriate alpha-character, numeric or iconic combinations on the subscriber interface. In the preferred embodiment, the set top terminal 220 generates the menus that are displayed on the television by creating arrays of particular menu templates, and the set top terminal 220 displays a specific menu or submenu option for each available video signal.

3. Operations Center and Digital Compression System

The operations center 202 performs two primary services, packaging television programs and generating the program control information signal. At the operations center 202, television programs are received from external program sources in both analog and digital form. Figure 2 shows an embodiment of the operations center receiving signals from various external sources 212. Examples of the external program sources are sporting events, children's programs, specialty channels, news or any other program source that can provide audio or visual signals. Once the programs are received from the external program sources, the operations center 202 digitizes (and preferably compresses) any program signals received in analog form. The operations center 202 may also maintain an internal storage of programs. The internally stored programs may be in analog or digital form and stored on permanent or volatile memory sources, including magnetic tape or RAM. Subsequent to receiving programming, the operations center 202 packages the programs into the groups and categories which provide the optimal marketing of the programs to subscribers. For

example, the operations center 202 may package the same programs into different categories and menus for weekday, prime-time viewing and Saturday afternoon viewing. Also, the operations center 202 packages the television programs in a manner that enables both the various menus to easily represent the programs and the subscribers to easily access the programs through the menus.

The packaging of the digital signals is typically performed at the operations center 202 by computer assisted packaging equipment (CAP). The CAP system normally includes at least one computer monitor, keyboard, mouse, and standard video editing equipment. A programmer packages the signals by entering certain information into the CAP. This information includes the date, time slot, and program category of the various programs. The programmer and the CAP utilize demographic data and ratings in performing the packaging tasks. After the programmer selects the various programs from a pool of available programs and inputs the requisite information, the programmer, with assistance from the CAP, can select the price and allocate transponder space for the various programs. After the process is complete, the CAP displays draft menus or program schedules that correspond to the entries of the programmer. The CAP may also graphically display allocation of transponder space. The programmer may edit the menus and transponder allocation several times until satisfied with the programming schedule. During the editing, the programmer may direct the exact location of any program name on a menu with simple commands to the CAP.

The packaging process also accounts for any groupings by satellite transponder which are necessary. The operations center 202 may send different groups of programs to

different cable headends 208 and/or set top terminals 220. One way the operations center 202 may accomplish this task is to send different program packages to each transponder. Each transponder, or set of transponders, then relays a specific program package to specific cable headends 208 and/or set top terminals 220. The allocation of transponder space is an important task performed by the operations center 202.

The operations center 202 may also "insert" directions for filling local available program time in the packaged signal to enable local cable and television companies to fill the program time with local advertising and/or local programming. Consequently, the local cable headends 208 are not constrained to show only programs transmitted from the operations center 202. New set top converters will incorporate both digital and analog channels. Therefore, the cable headend 208 may combine analog signals with the digital signals prior to transmitting the program signals to the set top terminals 220.

After the CAP packages the programs, it creates a program control information signal to be delivered with the program package to the cable headend 208 and/or set top terminal 220. The program control information signal contains a description of the contents of the program package, commands to be sent to the cable headend 208 and/or set top terminal 220, and other information relevant to the signal transmission.

In addition to packaging the signal, the operations center 202 employs digital compression techniques to increase existing satellite transponder capacity by at least a 4:1 ratio, resulting in a four-fold increase in program delivery capability. A number of digital compression algorithms

currently exist which can achieve the resultant increase in capacity and improved signal quality desired for the system. The algorithms generally use one or more of three basic digital compression techniques: (1) within-frame (intraframe) compression, (2) frame-to-frame (interframe) compression, and (3) within carrier compression. Specifically, in the preferred embodiment, the MPEG 2 compression method is used. After digital compression, the signals are combined (multiplexed) and encoded. The combined signal is subsequently transmitted to various uplink sites 204.

There may be a single uplink site 204 or multiple uplink sites (represented by 204', shown in phantom in Figure 1) for each operation center 202. The uplink sites 204 may either be located in the same geographical place or may be located remotely from the operations center 202. Once the composite signal is transmitted to the uplink sites 204, the signal may be multiplexed with other signals, modulated, upconverted and amplified for transmission over satellite. Multiple cable headends 208 may receive such transmissions.

In addition to multiple uplinks, the delivery system 200 may also contain multiple operations centers. The preferred method for using multiple operations centers is to designate one of the operations centers as a master operations center and to designate the remaining operations centers as slave operations centers. In this configuration, the master operations center coordinates various functions among the slave operations centers such as synchronization of simultaneous transmissions and distributes the operations workload efficiently.

4. Cable Headend

After the operations center 202 has compressed and encoded the program signals and transmitted the signals to the satellite, the cable headend 208 receives and further processes the signals before they are relayed to each set top terminal 220. Each cable headend site is generally equipped with multiple satellite receiver dishes. Each dish is capable of handling multiple transponder signals from a single satellite and sometimes from multiple satellites.

As an intermediary between the set top terminals 220 and the operations center 202 (or other remote site), the cable headend 208 performs two primary functions. First, the cable headend 208 acts as a distribution center, or signal processor, by relaying the program signal to the set top terminal 220 in each subscriber's home. In addition, the cable headend 208 acts as a network controller 214 by receiving information from each set top terminal 220 and passing such information on to an information gathering site such as the operations center 202.

Figure 3 shows an embodiment where the cable headend 208 and the subscriber's home are linked by certain communications media 216. In this particular embodiment, analog signals, digitally compressed signals, other digital signals and up-stream/interactivity signals are sent and received over the media 216. The cable headend 208 provides such signaling capabilities in its dual roles as a signal processor 209 and network controller 214.

As a signal processor 209, the cable headend 208 prepares the program signals that are received by the cable headend 208 for transmission to each set top terminal 220. In the preferred system, the signal processor 209 re-routes or demultiplexes and recombines the signals and digital information received from the operations center 202 and

allocates different portions of the signal to different frequency ranges. Cable headends 208 which offer different subscribers different program offerings may allocate the program signals from the operations center 202 in various manners to accommodate different viewers. The signal processor 209 may also incorporate local programming and/or local advertisements into the program signal and forward the revised signal to the set top terminals 220. To accommodate this local programming availability, the signal processor 209 must combine the local signal in digital or analog form with the operations center program signals. If the local cable system uses a compression standard that is different than the one used by the operations center 202, the signal processor 209 must also decompress and recompress incoming signals so they may be properly formatted for transmission to the set top terminals 220. This process becomes less important as standards develop (i.e., MPEG 2). In addition, the signal processor 209 performs any necessary signal decryption and/or encryption.

As a network controller 214, the cable headend 208 performs the system control functions for the system. The primary function of the network controller 214 is to manage the configuration of the set top terminals 220 and process signals received from the set top terminals 220. In the preferred embodiment, the network controller 214 monitors, among other things, automatic poll-back responses from the set top terminals 220 remotely located at each subscribers' home. The polling and automatic report-back cycle occurs frequently enough to allow the network controller 214 to maintain accurate account and billing information as well as monitor authorized channel access. In the simplest embodiment, information to be sent to the

network controller 214 will be stored in RAM within each subscriber's set top terminal 220 and will be retrieved only upon polling by the network controller 214. Retrieval may, for example, occur on a daily, weekly or monthly basis. The network controller 214 allows the system to maintain complete information on all programs watched using a particular set top terminal 220.

The network controller 214 is also able to respond to the immediate needs of a set top terminal 220 by modifying a program control information signal received from the operations center 202. Therefore, the network controller 214 enables the delivery system to adapt to the specific requirements of individual set top terminals 220 when the requirements cannot be provided to the operations center 202 in advance. In other words, the network controller 214 is able to perform "on the fly programming" changes. With this capability, the network controller 214 can handle sophisticated local programming needs such as, for example, interactive television services, split screen video, and selection of different foreign languages for the same video. In addition, the network controller 214 controls and monitors all compressors and decompressors in the system.

The delivery system 200 and digital compression of the preferred embodiment provides a one-way path from the operations center 202 to the cable headend 208. Status and billing information is sent from the set top terminal 220 to the network controller 214 at the cable headend 208 and not directly to the operations center 202. Thus, program monitoring and selection control will take place only at the cable headend 208 by the local cable company and its decentralized network controllers 214 (i.e., decentralized relative to the operations center 202, which is central to the

program delivery system 200). The local cable company will in turn be in communication with the operations center 202 or a regional control center (not shown) which accumulates return data from the set top terminal 220 for statistical or billing purposes. In alternative system embodiments, the operations center 202 and the statistical and billing sites are collocated. Further, telephone lines with modems are used to transfer information from the set top terminal 220 to the statistical and billing sites.

5. Set Top Terminal

The set top terminal 220 is the portion of the delivery system 200 that resides in the home of a subscriber. The set top terminal 220 is usually located above or below the subscriber's television, but it may be placed anywhere in or near the subscriber's home as long as it is within the range of the subscriber's remote control device 900. In some aspects, the set top terminal 220 may resemble converter boxes already used by many cable systems. For instance, each set top terminal 220 may include a variety of error detection, decryption, and coding techniques such as anti-taping encoding. However, it will become apparent from the discussion below that the set top terminal 220 is able to perform many functions that an ordinary converter box cannot perform.

The set top terminal 220 has a plurality of input and output ports to enable it to communicate with other local and remote devices. The set top terminal 220 has an input port that receives information from the cable headend 208. In addition, the unit has at least two output ports which provide communications from the set top terminal 220 to a television and a VCR. Certain menu selections may cause the set top terminal 220 to send control signals directly to the VCR to

automatically program or operate the VCR. Also, the set top terminal 220 contains a phone jack which can be used for maintenance, trouble shooting, reprogramming and additional customer features. The set top terminal 220 may also contain stereo/audio output terminals and a satellite dish input port.

Functionally, the set top terminal 220 is the last component in the delivery system chain. The set top terminal 220 receives compressed program and control signals from the cable headend 208 (or, in some cases, directly from the operations center 202). After the set top terminal 220 receives the individually compressed program and control signals, the signals are demultiplexed, decompressed, converted to analog signals (if necessary) and either placed in local storage (from which the menu template may be created), executed immediately, or sent directly to the television screen.

After processing certain signals received from the cable headend 208, the set top terminal 220 is able to store menu templates for creating menus that are displayed on a subscriber's television by using an array of menu templates. Before a menu can be constructed, menu templates must be created and sent to the set top terminal 220 for storage. A microprocessor uses the control signals received from the operations center 202 or cable headend 208 to generate the menu templates for storage. Each menu template may be stored in volatile memory in the set top terminal 220. When the set top terminal receives template information it demultiplexes the program control signals received from the cable headend 208 into four primary parts: video, graphics, program logic and text. Each menu template represents a different portion of a whole menu, such as a menu

background, television logo, cursor highlight overlay, or other miscellaneous components needed to build a menu. The menu templates may be deleted or altered using control signals received from the operations center 202 or cable headend 208.

Once the menu templates have been stored in memory, the set top terminal 220 can generate the appropriate menus. In the preferred embodiment, the basic menu format information is stored in memory located within the set top terminal 220 so that the microprocessor may locally access the information from the set top terminal instead of from an incoming signal. The microprocessor next generates the appropriate menus from the menu templates and the other menu information stored in memory. The set top terminal 220 then displays specific menus on the subscriber's television screen that correspond to the inputs the subscriber selects.

If the subscriber selects a specific program from a menu, the set top terminal 220 determines on which channel the program is being shown, demultiplexes and extracts the single channel transmitted from the cable headend 208. The set top terminal 220 then decompresses the channel and, if necessary, converts the program signal to an analog NTSC signal to enable the subscriber to view the selected program. The set top terminal 220 can be equipped to decompress more than one program signal, but this would unnecessarily add to the cost of the unit since a subscriber will generally only view one program at a time. However, two or three decompressors may be desirable to provide picture-on-picture capability, control signal decompression, enhanced channel switching or like features.

In addition to menu information, the set top terminal 220 may also store text transmitted from the cable headend 208 or the operations center 202. The text may inform the subscriber about upcoming events, billing and account status, new subscriptions, or other relevant information. The text will be stored in an appropriate memory location depending on the frequency and the duration of the use of the textual message.

Also, optional upgrades are available to enhance the performance of a subscriber's set top terminal 220. These upgrades may consist of a cartridge or computer card (not shown) that is inserted into an expansion slot in the set top terminal 220 or may consist of a feature offered by the cable headend 208 or operations center 202 to which the user may subscribe. Available upgrades may include on line data base services, interactive multi-media services, access to digital radio channels, and other services.

In the simplest embodiment, available converter boxes such as those manufactured by General Instruments or Scientific Atlanta, may be modified and upgraded to perform the functions of a set top terminal 220. The preferred upgrade is a circuit card with a microprocessor which is electronically connected to or inserted into the converter box.

6. Remote Control Device

The primary conduit for communication between the subscriber and the set top terminal 220 is through the subscriber interface, preferably a remote control device 900. Through this interface, the subscriber may select desired programming through the system's menu-driven scheme or by directly accessing a specific channel by entering the actual channel number. Using the interface, the subscriber can

navigate through a series of informative program selection menus. By using menu-driven, iconic or alpha-character access, the subscriber can access desired programs by simply pressing a single button rather than recalling from memory and pressing the actual channel number to make a selection. The subscriber can access regular broadcast and basic cable television stations by using either the numeric keys on the remote control 900 (pressing the corresponding channel number), or one of the menu icon selection options.

In addition to enabling the subscriber to easily interact with the cable system 200, the physical characteristics of the subscriber interface 900 should also add to the user friendliness of the system. The remote control 900 should easily fit in the palm of the user's hand. The buttons of the preferred remote control 900 contain pictorial symbols that are easily identifiable by the subscriber. Also, buttons that perform similar functions may be color coordinated and consist of distinguishing textures to increase the user friendliness of the system.

7. Menu-Driven Program Selection

The menu-driven scheme provides the subscriber with one-step access to all major menus, ranging from hit movies to sport specials to specialty programs. From any of the major menus, the subscriber can in turn access submenus and minor menus by cursor or alpha-character access.

There are two different types of menus utilized by the preferred embodiment, the Program Selection menus and the During Program menus. The first series of menus, Program Selection menus, consists of an Introductory, a Home, Major menus, and Submenus. The second series of menus, During Program menus, consists of two primary types, Hidden menus and the Program Overlay menus.

Immediately after the subscriber turns on the set top terminal 220, the Introductory menu welcomes the subscriber to the system. The Introductory menu may display important announcements from the local cable franchise, advertisements from the cable provider, or other types of messages. In addition, the Introductory menu can inform the subscriber if the cable headend 208 has sent a personal message to the subscriber's particular set top terminal 220.

After the Introductory menu has been displayed the subscriber may advance to the next level of menus, namely the Home menu. In the preferred embodiment, after a certain period of time, the cable system will advance the subscriber by default to the Home menu. From the Home menu, the subscriber is able to access all of the programming options. The subscriber may either select a program directly by entering the appropriate channel number from the remote control 900, or the subscriber may sequence through incremental levels of menu options starting from the Home menu. The Home menu lists categories that correspond to the first level of menus called Major menus.

If the subscriber chooses to sequence through subsequent menus, the subscriber will be forwarded to the Major menu that corresponds to the chosen category from the Home menu. The Major menus further refine a subscriber's search and help guide the subscriber to the selection of his choice.

From the Major menus, the subscriber may access several submenus. From each submenu, the subscriber may access other submenus until the subscriber finds a desired television program. Similar to the Major menu, each successive level of Submenus further refines the subscriber's search. The system also enables the subscriber to skip

certain menus or submenus and directly access a specific menu or television program by entering the appropriate commands on the remote control 900.

The During program menus (including Hidden Menus and Program Overlay Menus) are displayed by the set top terminal 220 only after the subscriber has selected a television program. In order to avoid disturbing the subscriber, the set top terminal 220 does not display the Hidden Menus until the subscriber selects the appropriate option to display a Hidden Menu. The Hidden Menus contain options that are relevant to the program selected by the viewer. For example, a Hidden Menu may contain options that enable a subscriber to enter an interactive mode or escape from the selected program.

Program Overlay Menus are similar to Hidden Menus because they occur during a program and are related to the program being viewed. However, the Program Overlay Menus are displayed concurrently with the program selected by the subscriber. Most Program Overlay Menus are small enough on the screen to allow the subscriber to continue viewing the selected program comfortably.

B. <u>Detailed Set Top Terminal Description</u>

The set top terminal 220 receives and manipulates signals from the cable headend 208. The set top terminal 220 is equipped with local computer memory and the capability of interpreting the digitally compressed signal to produce menus for the subscriber. The remote control 900 communicates the subscriber's selections to the set top terminal 220. The subscriber's selections are generally based upon menus or other prompts displayed on the television screen.

It is preferred that the signal reaches the subscriber's home in a compressed format and is decompressed prior to viewing. Included in the delivered program signal is information that enables equipment at the subscriber's home to display menus for choosing particular programs. Depending on the particular embodiment, the television program signal may arrive at the subscriber's home through one or more connections such as coaxial cables, fiber cables, twisted pairs, cellular telephone connections, or personal communications network (PCN) hookups.

The program control information signal is generated by the operations center 202 and provides the network controller 214 with data on the scheduling and description of programs. In an alternate configuration, this data is sent directly to the set top terminal 220 for display to the subscriber. In the preferred embodiment, the program control information signal is stored and modified by the network controller 214 and sent to the set top terminal 220 in the form of a set top terminal control information stream (STTCIS). The set top terminal 220 integrates either the program control information signal or the STTCIS with data stored in the memory of the set top terminal 220 to generate on-screen menus that assist the subscriber in choosing programs for display.

The types of information that can be sent using the program control signal include: number of program categories, names of program categories, what channels are assigned to a specific category (such as specialty channels), names of channels, names of programs on each channel, program start times, length of programs, description of programs, menu assignment for each program, pricing, whether there is a sample video clip for advertisement for

the program, and any other program, menu or product information.

With a minimal amount of information being communicated to the set top terminal 220 on a regular basis, the set top terminal 220 is able to determine the proper menu location for each program and the proper time and channel to activate for the subscriber after a menu selection. The program control information signal and STTCIS can be formatted in a variety of ways and the on-screen menus can be produced using many different methods. For instance, if the program control information signal carries no menu format information, the menu format for creating the menus can be fixed in ROM at the set top terminal 220. In the preferred embodiment, the menu format information is stored at the set top terminal 220 in a temporary memory device such as a RAM or EPROM. New menu format information is sent via the program control information signal or the STTCIS to the set top terminals 200 whenever a change to a menu format is desired.

In the simplest embodiment, the menu formats remain fixed and only the text changes. In this way the program control information signal can be limited to primarily text and a text generator can be employed in the set top terminal 220. Another simple embodiment uses a separate channel full-time (large bandwidth) just for the menu information.

Live video signals may be used in windows of certain menus. These video signals can be transmitted using the program control information signal or STTCIS, or can be taken off channels being transmitted simultaneously with the menu display. Video for menus, promos or demos may be sent to the set top terminal 220 in several formats, including (1) on a dedicated channel, (2) on a regular program channel

and scaled to size, or (3) along with the program control information signal. However, in the preferred embodiment, a large number of short promos or demo video is sent using a split screen technique on a dedicated channel. A multiple window technique may be used with the menus to display a description of a program and one or more video frames that assist the subscriber in selecting the program.

Figure 4 shows the basic hardware components of the set top terminal 220. The set top terminal 220 has a tuner 603, digital demodulator 606, decryptor 600, and demultiplexers 609, 616 as well as audio equipment 612 and a remote control interface 626 for receiving and processing signals from the remote control unit 900. An optional modem 627 allows communication between a microprocessor 602 and the cable headend 208. An NTSC encoder 625 provides a standard NTSC video output.

The microprocessor 602 is capable of executing program instructions stored in memory. These instructions allow a user to access various menus by making selections on the remote control 900.

The manner in which the video is decompressed and the menus are generated from the program control information signal or STTCIS varies depending on the specific embodiment of the invention. Video decompressors 618 and 622 may be used if the video is compressed. The program control information signal may be demultiplexed into its component parts, and a video decompressor 618, graphic decompressor, text generator and video combiner 624 may be used to assist in creating the menus.

In addition to the menu format information that is stored in graphics memory, the set top terminal 220 also stores data, tracking those programs that have been selected

for viewing. By gathering this data, the set top terminal 220 can maintain an accurate record of all programs accessed/watched by storing the data in EEPROM or RAM. Subsequently, this data can be transmitted to the cable headend 208, where it can be used in carrying out network control and monitoring functions. Such data transmissions between the set top terminal 220 and cable headend 208 can be accomplished, for example, through upstream transmission over the cable network or over telephone lines through the use of telephone modems. Where upstream transmission over the cable network is used, the set top terminals 220 can complete data transmissions on a scheduled (e.g., using a polling response or status report to respond to polling requests sent from the cable headend 208) or as-needed (e.g., using a random access technique) basis.

Figure 5a shows the front panel of the set top terminal 220, which includes an infrared sensor 630 and a series of LED displays 640. The LED displays 640 may indicate with an icon or a letter (e.g. A-K) the major menu currently selected by the set top terminal 220 or the channels selected directly by a user, or menu channel selections (e.g., from 1 to 50). Further displays may include current channel, time, volume level, sleep time, parental lock (security), account balance, use of a hardware upgrade, second channel being recorded by VCR, use of the Level D music hardware upgrade in a separate room, and any other displays useful to a subscriber to indicate the current status of the set top terminal 220. The LEDs 640 may also provide an indication of the digital audio channel currently tuned.

The set top terminal 220 includes a flapped opening 635 on its front that allows the insertion of a magnetic

cartridge (or similar portable storage device, including optical disk, ROM, EPROM, etc. not shown). This cartridge opening 635 allows the set top terminal 220 to be upgraded or reprogrammed locally with the use of a magnetic tape cartridge.

On the top or cover of the set top terminal 220 are located pushbutton controls 645. Any function that can be performed on the remote 900 may also be performed at the set top terminal 220 using the duplicative pushbutton controls 645.

Figure 5b shows the back of the set top terminal 220, which includes a pair of output terminals 650, pair of input terminals 652, pair of stereo/audio output terminals 654, satellite dish input port 656, telephone jack 658 and an RS-422 port 660. In addition, an upgrade port 662 and a cover plate 664 are held in place by a series of sheet metal screws. One of the output terminals 650 is for a television and the other is for a VCR. The set top terminal 220 is equipped to handle incoming signals on one or two cables using the input terminals 652. The phone jack 658 and an RS-232 or RS-422 port 660 are provided for maintenance, trouble shooting, reprogramming and additional customer features. In alternate embodiments, the telephone jack 658 may be used as the primary mode of communication between the cable headend 208 and the set top terminal 220. This connection is possible through the local telephone, cellular telephone or a personal communications network (PCN).

The basic programming of each set top terminal 220 is located on ROM within the set top terminal 220. Random access memory, the magnetic cartridge capability, and the expansion card slot 635 each allow upgrades and changes to be easily made to the set top terminal 220.

In the preferred embodiment, the set top terminal 220 includes a hardware upgrade port 662, in addition to expansion card slots. The hardware upgrade port 662 accommodates a four-wire (or more) connection for: (1) error corrected, decrypted data output of the set top terminal 220, (2) a control interface, (3) decompressed video output, and (4) a video input port. In the preferred embodiment, multiple wires are used to perform each of the four functions. The four sets of wires are combined in a single cable with a single multipin connector.

In the preferred embodiment, multipin connections may be used for the multiwire cable. The multipin connection 662 may range from DB9 to DB25. A variety of small computer systems interface (SCSI) ports may also be provided. Alternatively, four or more ports may be provided instead of the single port depicted.

Another port 662 is used to attach the various hardware upgrades described below to a set top terminal 220. The preferred embodiment has a number of hardware upgrades available for use with a set top terminal 220, including: (1) a Level A interactive unit, (2) a Level B interactive unit, (3) a Level C interactive unit with compact disc capability, (4) a Level D digital radio tuner for separate room use, and (5) a Level E information download unit. Each of these upgrades may be connected to the set top terminal 220 unit through the upgrade port 662 described earlier. The same four wires in a single cable described earlier may be used.

Existing set top converter boxes such as those made by Scientific Atlanta or General Instruments are presently unequipped to handle the menu selection system of the present invention. Thus, hardware modifications are

necessary in order to use the menu selection system with existing set top converter technology.

A Turbo Card addition to a set top converter is depicted in Figure 6. The Turbo Card 700 shown provides the additional functionality needed to utilize the menu system with existing set top converter technology. The primary functions the Turbo Card 700 adds to the set top converter are the interpreting of program control information signals, generating of menus, sequencing of menus, and, ultimately, the ability of the viewer to select a channel through the menu system without entering any channel identifying information. The turbo card also provides a method for a remote location, such as the cable headend 208, to receive information on programs watched and control the operation of the set top converter and Turbo Card 700. The programs watched information and control commands may be passed from the cable headend 208 to the Turbo Card 700 using telephone lines.

The primary components of the Turbo Card 700 are a PC chip CPU 702, a VGA graphic controller 704, a video combiner 706, logic circuitry 708, NTSC encoder 710, a receiver 712, demodulator 714, and a dialer 716. The Turbo Card 700 operates by receiving the program control information signal from the cable headend 208 through the coaxial cable. The logic circuitry 708 of the Turbo Card 700 receives data, infrared commands, and synchronization signals from the set top converter. Menu selections made by the viewer on the remote control 900 are received by the set top converter's IR equipment and passed through to the Turbo Card 700. The Turbo Card 700 interprets the IR signal and determines the program (or menu) the viewer has selected. The Turbo Card 700 modifies the IR command to

send the program selection information to the set top converter 221. The modified IR command contains the channel information needed by the set top converter. Using the phone line and dialer 716, the Turbo Card 700 is able to transmit program access information to the cable headend 208.

In the preferred embodiment, program access information, that is what programs the viewer watched, is stored at each set top terminal 220 until it is polled by the network controller 214 using a polling request message format as shown in Figure 7a. This frame format 920 consists of six fields, namely: (1) a leading flag 922 at the beginning of the message, (2) an address field 924, (3) a subscriber region designation 926, (4) a set top terminal identifier 928 that includes a polling command/response (or P/F) bit 930, (5) an information field 932, and (6) a trailing flag 934 at the end of the message. Figure 7b shows a response frame format 920' (similar to the frame format 920 end, therefore, commonly numbered with the frame depicted in Figure 7a, but with the prime indicator added for clarity) for information communicated by the set top terminal 220 to the network controller 214 in response to the polling request of Figure 7a.

The eight-bit flag sequence 922 that appears at the beginning and end of a frame is used to establish and maintain synchronization. Such a sequence typically consists of a "01111110" bit-stream. The address field 924 designates a 4-bit address for a given set top terminal 220. The subscriber region designation 926 is a 4-bit field that indicates the geographical region in which the subscriber's set top terminal 220 is housed. The set top terminal identifier 928 is a 16-bit field that uniquely identifies each set top terminal 220 with a 15-bit designation followed by an

appended P/F bit 930. Although field size is provided by this example, a variety of sizes can be used with the present invention.

The P/F bit 930 is used to command a polling response from the set top terminal 220 addressed, as described below. The response frame format 920' also provides a variable-length information field 932' for other data transmissions, such as information on system updates. The frame format 920' ends with an 8-bit flag (or trailing flag) 934' that is identical in format to the leading flag 922', as set forth above. Other frame formats (e.g., MPEG) will be apparent to one skilled in the art and can be easily adapted for use with the system.

As summarized above, images or programs may be selected for display by sequencing through a series of menus. Figure 8 is an example of one possible structure for a series of menus. Generally, the sequence of menus is structured with an introductory menu, a home menu, various major menus and a multitude of submenus. The submenus can include promo menus and during program menus. For example, at the home menu portion of the sequence of menus and corresponding software routines, a subscriber may select one of the major menus and start a sequence of menu displays. Alternatively, a subscriber may go directly to a major menu by depressing a menu select button on remote control 900.

At any time during the menu sequence, the subscriber may depress a major menu button to move into another series of menus. In this way, a subscriber may move from major menu to major menu.

The various software subroutines executed by the microprocessor 602 allow a subscriber to sequence the menus, navigating through the various menus of the present

invention. A subscriber may sequence back through menus or return to the home menu with a single touch of the home menu button on remote 900.

An introductory menu screen 1000 automatically appears upon power-up and initialization of the set top terminal 220. From this introductory menu screen 1000, the set top terminal software will normally advance the subscriber to the home menu screen 1010. The home menu 1010 is the basic menu that the subscriber will return to in order to make the first level of viewing decisions. When the set top terminal software is displaying the home menu 1010, the subscriber is able to access any television programming option. The software allows programming options to be entered through cursor movement on the screen and directly by button selection on the remote control 900.

In the normal progression through the menu screens, the software will forward the subscriber to a major menu screen 1020 in response to the subscriber's remote control 900 selection or highlighted cursor selection from the home menu screen 1010. The selections displayed on the home menu 1010 are for large categories of programming options.

Following the major menu 1020, the subscriber may navigate through one or more submenu screens 1050 from which the subscriber may choose one particular program for viewing. For most programming selections, the user will proceed from the home menu 1010 to a major menu 1020 and then to one or more submenus 1050. However, for certain programming options or functions of the set top terminal 220, the user may skip one or more menus in the sequence.

The During Program Menus 1200 are submenus enabled by the set top terminal software only after the

subscriber has selected a television program. These menus provide the subscriber with additional functionality and/or additional information while viewing a selected program. The During Program Menus 1200 sequence can be further subdivided into at least two types of menus, Hidden Menus 1380 and Program Overlay Menus 1390.

To avoid disturbing a subscriber during viewing of a program, the Hidden Menus 1380 are not shown to the subscriber but instead "reside" at the set top terminal 220 microprocessor 602. The microprocessor 602 awaits a button entry either from the remote control 900 or set top terminal 220 buttons before executing or displaying any Hidden Menu 1380 options. The set top terminal software provides the subscriber with additional functions such as entering an interactive mode or escaping from a selected program through use of Hidden Menus 1380.

Program Overlay Menus 1390 are similar to Hidden Menus 1380. However, the Program Overlay Menus 1390 are overlayed onto portions of the displayed video and not hidden. The software for the Program Overlay Menus 1390 allows the subscriber to continue to watch the selected television program with audio but places graphical information on a portion of the television screen. Most Program Overlay Menus 1390 are graphically generated to cover small portions of video. Some Overlays 1390 which are by their nature more important than the program being viewed will overlay onto greater portions of the video. Examples of types of overlay menus 1390 include Notification Menus 1392 and Confirmation Menus 1394. In the preferred embodiment, the software for the Program Overlay Menus 1390 controls the reduction or scales down the (entire)

programs video and redirects the video to a portion of the screen.

Submenus provide the cost of viewing the program and the program's length in hours and minutes. From the submenus, the subscriber is given at least three options: (1) to purchase a program, (2) to return to the previous menu, and (3) to press "go" and return to regular TV. The subscriber may also be given other options such as previewing the program.

Using an on-screen menu approach to program selection, there is nearly an unlimited number of menus that can be shown to the subscriber. The memory capability of the set top terminal 220 and the quantity of information that is sent using the program control information signal are the only limits on the number of menus and amount of information that can be displayed to the subscriber. The approach of using a series of menus in a simple tree sequence is both easy for the subscriber to use and simply implemented by the set top terminal 220 and remote control device 900 with cursor movement. A user interface software programmer will find many obvious variations from the preferred embodiment described.

The set top terminal 220 generates and creates menus using, in part, information stored in its graphics memory. A background graphics file 800 will store menu backgrounds and a logo graphics file will store any necessary logos. A menu display and cursor graphics file will store menu display blocks and cursor highlight overlays as well as any other miscellaneous files needed to build the menus. Using this method of storing menus, the menus can be changed by reprogramming the graphics memory of the set top terminal

220 through instructions from either the network controller 214 or operations center 202.

The microprocessor 602 performs the steps required to create a menu using stored information. The microprocessor 602 fetches a background file, logo file, menu display and cursor file in most instances. The microprocessor 602 fetches text from long-term, intermediate-term, or short-term storage depending on where the text is stored. Using a video combiner (or like device), the stored information is combined with video and the entire image is sent to the television screen for display.

In the preferred embodiment, a graphics controller is used to assist the set top terminal 220 in generating menus. Menu generation by the set top terminal 220 begins with the building of a major menu screen, which includes background graphics for that major menu. The background graphics may include an upper sash across the top of the screen and a lower sash across the bottom of the screen. The background graphics may be generated from the background graphics file 800 in the memory files of the graphics memory (preferably EEPROM). In addition, logo graphics may be generated. Such graphics typically include an icon window, a cable company logo, a channel company logo, and two "go" buttons.

Preferably, the text for each major menu is generated separately by a text generator in the set top terminal 220. Those portions of the text that generally remain the same for a period of weeks or months may be stored in EEPROM or other local storage. Text which changes on a regular basis, such as the movie titles (or other program selections), is transmitted to the set top terminal 220 by either the operations center 202 or the network controller 214 of the cable headend 208. In this manner, the cable headend 208

may change the program selections available on any major menu 1020 by modifying the program control information signal sent by the operations center 202 and transmitting any changes using the STTCIS.

Day, date and time information are added to each major menu. This information is sent from the operations center 202, the cable headend 208 (signal processor 209 or network controller 214), the uplink site, or generated by the set top terminal 220 internally.

The creation and display of program description submenus is performed by the set top terminal 220 in a manner similar to that described above. Each submenu may be created in parts and combined before being sent to the television screen. Preferably, background graphics and upper and lower sashes are used. Likewise, a video window and half-strip window can be generated from information in storage on the EEPROM.

In addition to graphics and text, some submenus include windows that show video. Such video may be still or moving pictures. Still pictures may be stored in a compressed format (such as JPEG) at the set top terminal 220. Video stills may be transmitted by the operations center 202 through the program control information signal from time to time.

Moving video picture is obtained directly from a current video feed as described above. Depending on video window size, this may require manipulation of the video signal, including scaling down the size of the video and redirecting the video to the portion of the menu screen which is within the video window of the menu. Alternatively, the video may be obtained from a split screen channel. Such a method involves the use of split screen video techniques to send

multiple video clips on a single channel at a given time. The set top terminal 220 would scale the picture, if necessary, and redirect it to the correct position on the screen using known scaling and positioning techniques. Additional circuitry may be required in the set top terminal 220 to perform adequate scaling and repositioning.

To avoid the need for redirecting video into the portion of the screen which houses the video window, masking and menu graphics may be used to cover the portions of the channel video that are not needed. This masking technique allows the split screen video to remain in the same portion of the screen that it is transmitted by the operations center 202. The masking is then adjusted to cover the undesired portions of the screen. These masks are stored in the background graphics file similarly to other background files for menus.

The split screen video technique may also be used for promoting television programming. Since a great number of short video clips may be sent continuously, full or partial screen promotionals (or informationals) may be provided to the subscriber. With this large quantity of promotional video, the subscriber is given the opportunity to "graze" through new movie or television programming selections. The subscriber simply grazes from promotional video to promotional video until the desired television program is discovered.

C. Detailed Description of Advanced Set Top Terminal

1. Overview

The present invention relates to advances in the set top terminal 220 described above. In particular, the present invention may be achieved through a set of hardware

upgrades or additions to the following embodiments: (1) an existing set top converter (not shown) upgraded with a Turbo Card 700 or the like; (2) an industry standard digital decompression converter box (as shown in Figures 9a and 9b below) upgradeable by either an upgrade module or a menu generation card; or (3) a set top terminal 200 capable of both decompression and menu generation. The set of hardware upgrades described below can be used to provide additional advanced features and functional capabilities to any of these embodiments.

Table A shows several exemplary hardware configurations that may be used to achieve the goals of the present invention. In particular, Table A shows four columns of set top converter technology, which may be modified to produce the various set top capabilities shown in the three rows of the table.

TABLE A

	Existing Analog Set Top Converter	Set Top Converter With Digital Decompression Capability	Set Top Converter With Digital Decompression and Menu Generation Capabilities	Advanced Set Top Terminal
Decompression Capability	N/A	Built-In	Built-In	Built-In
Menu Generation Capability	Turbo Card	Upgrade Module or Menu Generation Card	Built-In	Built-In
Advanced Features	Level A-C Hardware Upgrades or Expansion Card	Level A-E Hardware Upgrades or Expansion Card	Level A-E Hardware Upgrades or Expansion Card	Built-In

The table shows the various inherent functional capabilities of each set top converter, and how each may be modified or upgraded, if necessary, to achieve the objectives of the present invention. From left to right, the columns of the table span the various alternatives for balancing those capabilities that may be built into set top converters or terminals, on the one hand, and those capabilities that can be provided through, for example, an upgrade module,

expansion card or hardware upgrade of the present invention, on the other. This balance allows a designer or manufacturer of set top converters to choose between adding advanced functionality to an existing converter box or, instead, producing a converter with additional built-in features that increase cost and complexity of the converter or terminal.

The first column of Table A shows how an existing analog set top converter can be modified to provide menu generation capability through the use of the Turbo Card. In addition to the Turbo Card, such an existing analog set top converter may be further modified to provide any of the advanced features described below through the use of the Level A, Level B and Level C hardware upgrades or an expansion card. Such existing set top converter boxes are currently manufactured by Scientific Atlanta and General Instruments, among others. These converter boxes have been designed for use with analog waveforms and, as a result, digital decompression capabilities are not applicable.

The second column of Table A shows a set top converter with digital decompression capability. This converter is a simple decompression box which may eventually become the industry standard. The simple decompression boxes may be modified to provide the enhanced functionality of the present invention. For example, a simple decompression box may be modified to produce menu generation capability through the use of an upgrade module or menu generation card. In addition, other advanced features may be added to a simple decompression box through modifications that include any of the Level A through E hardware upgrades or an expansion card. Each of these modifications are described below.

The third column of Table A shows a set top converter that has built-in digital decompression and menu generation capabilities. Thus, in order to achieve the enhanced functionality of the present invention, other advanced features may be provided through hardware modification. Such modification may be accomplished through the use of any of the Level A through E hardware upgrades or the expansion card, as explained below.

The fourth column of Table A shows an advanced set top terminal having decompression, menu generation, and advanced functional capabilities. Each of these capabilities are built in to the terminal itself. In this way, achieving the enhanced performance of the set top terminal in accordance with the present invention would require no hardware modification.

In the preferred embodiment, the advanced set top terminal 220 of the present invention has the capability, among other things, of receiving tiered programming from the network controller. Tiered programming allows different users to view different video even though the subscribers are "tuned" to the same channel. For example, the network controller 214 may know the demographics of its subscribers through a database, by "learning" from prior subscriber choices, from an interactive selection, or from other means. Using the demographics information, the network controller 214 may target commercials to the correct audience by showing different commercials to subscribers with different demographics. Even though subscribers will believe they are "tuned" to one channel, each subscriber will be switched to a different channel for the tiered video. Alternatively, subscribers may be offered an option of several commercials from which to choose.

To accommodate foreign speaking subscribers, multiple audio channels for television programming may be provided. In this way, the subscriber may be shown menus of programs available in the subscriber's native language. The function of choosing the correct audio to correspond to the selected language may be handled by either the set top terminal 220 or the network controller 214 depending upon the configuration. Local programming in several languages or additional audio channels for a foreign language translation of a popular television program may be provided by the network controller 214. Using a picture-on-picture feature, sign language may be similarly made available to certain set top terminals 220 for the deaf. Also, a text overlay may easily be produced on the lower part of the screen for the deaf.

Typically, each video signal is received at the set top terminal 220 along with four audio channels. Two of these audio channels will preferably be used for left and right stereo audio reception of the video signal being displayed. The remaining two audio signals may be used for alternative languages. For example, where a video signal is received by the set top terminal 220, two of the audio channels will provide the stereo audio signals for that video in English, with the other two audio channels providing mono audio signals in French and Spanish. In this way, each video signal received at the set top terminal 220 can accommodate at least two foreign languages. Where stereo audio channels are not desired, the audio channels in English can be set to a single signal, providing mono audio reception, and increasing the multiple language audio channel capability to three foreign languages.

In other embodiments, the network controller 214 can act as a central computer and provide intra-set top terminal

interactive games, inter-set top terminal interactive games, computer bulletin board type services, message services (Electronic mail) etc. For example, a subscriber may play war games with five (anonymous) fellow subscribers each in their own home each operating a separate tank. The network controller 214 gathers the players via set top terminal 220 communications and acts as the referee. A bulletin board or message system can be set up to discuss a particular program such as "Twin Peaks Whodunit" for enthusiasts. These interactive features are further described below with the interactive services level B menu and the set top terminal hardware upgrade level B interactive unit.

In order to achieve the required throughput of video and audio information for the system, digital compression techniques for video are employed. As a result, the set top terminal 220 typically must decompress any digitally compressed program signals that it receives. Methods of decompression are a function of the compression technique used in the program delivery system.

There are three basic digital compression techniques: within-frame (intraframe), frame-to-frame (interframe), and within-carrier compression. Various compression methods may be used with these techniques. Such methods of compression, which include vector quantization and discrete cosine transform methodologies, are known to those skilled in the art.

Several standard digital formats representing both digitizing standards and compression standards have also been developed. For example, JPEG (joint photographic experts group) is a standard for single picture digitization. Motion picture digitization may be represented by standards such as MPEG or MPEG 2 (motion picture engineering group

specification). In addition to these standards, other proprietary standards have been developed. Although MPEG and MPEG 2 for motion pictures are preferred in the present invention, any reliable digital format with compression may be used.

Various hybrids of the above compression techniques and methods have been developed by several companies including AT&T, Compression Labs, Inc., General Instruments, Scientific-Atlanta, Philips, and Zenith. Any of the compression techniques developed by these companies, as well as other techniques known to those skilled in the art, may be used with the present invention.

2. <u>Advanced Set Top Terminal Major Components and Upgrades</u>

a. <u>Decompression Box with Upgrade Module</u>

The preferred program delivery system uses digitally compressed signals and, as a result, the preferred subscriber equipment configuration must be capable of decompressing and processing such digitally compressed signals. Figure 9a diagrams the basic interplay between an upgrade module 700 and a simple decompression box 302. The upgrade module 300 can be connected to the decompression box 302 through a port similar to the upgrade port 662 described above (Figure 5b). The simple decompression box 302 shown is preferably a future industry standard decompression box capable of communicating with an upgrade module 300 to enhance functionality.

The upgrade module 300 provides menu generation capability to the simple decompression box 302. The microprocessor of the simple decompression box 302 communicates with the microprocessor in the upgrade

module 300 to provide the full functionality of a set top terminal 220.

In the preferred embodiment, multipin connections may be used for a multiwire cable connecting the simple decompression box 302 with the upgrade module 300. The multipin connection may range from DB9 to DB25. A SCSI, or small computer systems interface, port (not shown) may also be provided. Alternatively, four or more ports may be provided instead of the single port depicted. If a port is not provided, the upgrade module may, alternatively, be hard-wired to the simple decompression box 302.

As represented generally at 304, the digital data set of output wires of the simple decompression box 302 will preferably output error corrected and decrypted data to the upgrade module 300. The second set of wires, providing the interface connection, allows the microprocessor in the upgrade module 300 to communicate with the microprocessor of the simple decompression box 302. In this manner, the video circuitry of the upgrade module 300 and the simple decompression box 302 may maintain synchronization. The third set of wires, providing the decompressed video output, provide the upgrade module 300 with a decompressed video signal to manipulate. The fourth set of wires, comprising the video input set, allows the simple decompression box 302 to accept a video signal that is a combined text, graphics, and video signal.

Figure 9a further shows the CATV input 306, video input 308, and video and audio outputs 310, 312, as part of the simple decompression box 302. This embodiment reduces the component cost of upgrade module 300, and thus, is preferred. The upgrade module 300 may simply be a cartridge (not shown) insertable into the simple

decompression box 302. Alternatively, as shown in commonly numbered Figure 9b, the CATV input 306, video input 308 and video and audio outputs 310, 312 may be included as part of the upgrade module 300. In this embodiment, the simple decompression box 302 is primarily used for decompressing the video.

Referring to Figure 10, the upgrade module 300 preferably includes the following circuitry: a video graphics and text demultiplexer 314; a text and graphics video plane combiner 316; a run length graphics decompressor 318; and, a run length compressed graphics memory 320 (nonvolatile RAM, ROM, EPROM, or EEPROM). By means of communications through the multiwire connection between the upgrade module 300 and the simple decompression box 302, compressed video and control signals may be demultiplexed by the demultiplexer 314 within the upgrade module 300. The run length graphics decompressor 318, through communications with the run length compressed graphics RAM 320, permits decompression of the input compressed video signal. The text and graphics video plane combiner 316 allows demultiplexed and decompressed signals to be output, through the simple decompression box 302, to a subscriber's television 222 showing both video and overlay menus with text.

Figure 10 shows the elements of a simple decompression box 302 (numbered commonly with the elements of the set top terminal 220 depicted in Figure 4) with the upgrade module 300 described above. Generated menus and video are combined in the combiner 316 and output to an antitaping encoder 619. Any method of antitaping encoding known by those skilled in the art may be used with the present invention.

Figure 10 also depicts an expansion card 320 and an expansion card interface 320 for receiving the card 320. In addition, error correction circuitry 324 is shown receiving the demodulated signal, prior to demultiplexing the signal.

The enhanced functionality of the upgrade module 300 may alternatively be included on the expansion card 320. In this embodiment, the upgrade module 300 becomes an internal component of the simple decompression box 302 and internally upgrades the box 302 to include menu generation capability without using an external hardware upgrade module 300. Other variations in the upgrade module 300 configuration are also possible.

b. Upstream Data Transmission Hardware

Figure 11 shows a preferred set top terminal 220 that includes a data receiver 332 and a data transmitter 344. The data transmitter 344 provides upstream data communications capability between the set top terminal 220 and the cable headend 208. Upstream data transmissions are accomplished using the polling system described with reference to Figures 7a and 7b above, and, in particular, using a data transmitter 344. Both receiver 332 and transmitter 344 may be built into the set top terminal 220 itself or added through an upgrade module 300. Regardless of the specific hardware configuration, the set top terminal's data transmission capabilities may be accomplished using the hardware shown in Figure 11.

Figure 11 shows RF signals, depicted at 330, being received at by a data receiver 332 and tuner 603 working in unison. Both of these devices are interfaced with the microprocessor 602, which receives inputs, depicted at 338, from the subscriber, either through the set top terminal's

keypad 645 or remote control unit 900. All cable signals intended for reception on the subscriber's TV are accessed by the tuner 603 and subsequently processed by the processing circuitry 340. This processing circuitry 340 typically includes additional components for descrambling, demodulation, volume control and remodulation on a Channel 3 or 4 TV carrier.

Data targeted to individual set top terminals 220 is received by the data receiver 332 according to each set top terminal's specific address or ID (e.g. set top ID 928, 928'). In this way, each addressable set top terminal 220 only receives its own data. The data receiver 332 may receive set top terminal specific data in the information field of the program control information signal frame described with reference to Figure 7a or on a separate data carrier located at a convenient frequency in the incoming spectrum.

Any received data includes information regarding channels and programs available for selection. The subscriber may enter a series of commands using the keypad 645 or remote control 900 in order to choose a channel or program. Upon receipt of such commands, the set top terminal's microprocessor 602 instructs the tuner 603 to tune to the proper frequency of the channel or program desired and subsequently instructs the processing circuitry 340 to begin descrambling of this channel or program.

Upon selection of a channel or program, the microprocessor 602 stores any selection information in local memory for later data transmission back to the cable headend 208. Typically, the data transmitter 344 operates in the return frequency band between 5 and 30 MHz. In an alternative embodiment, the frequency band of 10 to 15 MHz may be used. Regardless, however, of the frequency band

used, the data transmitter 344 sends information to the cable headend 208 or network controller 214 in the information field of the frame described with reference to figure 7b. Those skilled in the art will recognize that a number of variations and combinations of the above-described set top terminal 220 hardware components may be used to accomplish upstream data transmissions.

c. Hardware Upgrades

In order to enhance a set top terminal's 220 functionality, the following hardware upgrades may be used: (1) a Level A interactive unit, (2) a Level B interactive unit, (3) a Level C interactive unit with compact disc capability, (4) a Level D digital radio tuner for separate room use, and (5) a Level E information download unit. Each of these upgrades is connected to the set top terminal 220 unit through the upgrade port 662 described earlier.

Level A, B and C hardware upgrades have similar hardware components. Figure 12a diagrams the basic components of the Level A, B and C hardware upgrades, indicated generally at 100. The figure diagrams the interaction between the hardware upgrades 100 and the set top terminal's 220 basic components. As seen in the figure, CATV input signals are received by the set top terminal 220 using a tuner 603 and various receiver components described above (but denoted generally at 601 in Figures 12a and 12b). The set top terminal's microprocessor coordinates all CATV signal reception and also interacts with various upstream data transmission components 604, which have been described above.

The Level A, B and C hardware upgrades 100 each include a microprocessor 104, interactive software 106, processing circuitry 108, bubble memory 112, and a long-

term memory device 116. In addition to these basic components, the Level B hardware upgrade makes use of an additional telephone modem 120, while the Level C hardware upgrade makes use of an additional CD-ROM storage device 122.

Along with their basic components, the Level A, B and C hardware upgrades 100 each use their own interactive software 106. This software may be used to provide the enhanced functional capabilities described below. The Level A, B and C hardware upgrades also make use of processing circuitry 108, which allows the set top terminal 220 to pass the subscriber's interactive input to the Level A, B and C hardware upgrades 100 for interpretation. These commands are passed through the interface linking the set top terminal's microprocessor with the microprocessor of the Level A, B and C hardware upgrades 100. In this way, subscriber inputs, entered through the set top terminal keypad or remote control, can be transferred to any of the hardware upgrades for processing and responses generated therein can then be sent back to the set top terminal 220 for display. In the preferred embodiment the IR commands are transferred from set top terminal to hardware upgrade.

The Level A, B and C hardware upgrades 100 also include a long-term memory component or device 116 that allows each hardware upgrade to internally store data used with each interactive service. Such data may include, for example, customized menu templates used by the individual interactive services. In addition, the Level A, B and C hardware upgrades include a bubble memory 112 for the temporary storage of, for example, interactive questions and responses used in each particular interactive service.

The Level A interactive unit allows the subscriber to access interactive services offering additional information about programs such as quizzes, geographical facts, etc. This information may be received by the set top terminal 220 in several data formats, including using the vertical blanking interval (VBI) or the program control information signal. The Level A interactive unit enables the subscriber to engage in textual interactivity with the current television program using overlay menus. Some examples are quizzes, fast facts, more info, where in the world, products, etc, all of which provide the subscriber with an interactive question and answer capability. Although the Level A interactive capability can easily be built into the set top terminal 220, such an embodiment increases the cost of the basic set top terminal 220.

The Level B interactive unit provides the user with access to online data base services for applications such as home shopping, airline reservations, news, financial services, classified advertising, home banking, and interactive teletext services. For example, with this upgrade, a user will be able to reserve plane tickets or buy consumer electronics. The primary feature of this upgrade unit is that it allows actual transactions using two-way communications over modem with outside services. This added two-way communications capability may be with the cable headend 208 or, alternatively, over cellular networks, PCN or other communications media.

The Level C interactive unit employs a high volume local storage capacity, including compact disc or other random access digital data formats (e.g., CD-ROM 122). This unit allows use of interactive multi-media applications. Such applications include, for example, computer games, multi-

media educational software, encyclopedias, other reference volumes (e.g. Shakespeare library), etc. In the preferred embodiment, many of these applications will interact with live programming providing additional information and interactivity to the basic program feed. For example, a viewer watching a show set in a foreign country may be able to retrieve additional information, maps, economic data, as well as other information about that country that are stored on the compact disc. In the Level C applications, the upgrade hardware may closely monitor the television broadcast through additional data channels (e.g., vertical blanking interval, or other digital data encoded within live video) providing context sensitive interactivity.

Figure 12b diagrams the interaction between the set top terminal 220 and the Level D hardware upgrade, indicated generally at 130. As shown in the figure, the CATV signals are input to the set top terminal 220 through its tuner 603 and receiver components 601. As described above, the microprocessor 602 coordinates all cable television signal reception by the set top terminal 220. The Level D hardware upgrade 130 makes use of a microprocessor 132, a tuner 134, a demodulator 136, a demultiplexer 138, a decryptor 140 and an audio decompressor 142.

As shown in the figure, the set top terminal 220 and the Level D hardware upgrade 130 interact through the interface linking the respective devices. The set top terminal's microprocessor 602 instructs received signals to be transferred to the Level D hardware upgrade 130 for further processing. These received signals are input to the Level D hardware upgrade, passed through the signal path comprising the tuner 134 and other digital audio reception components (i.e., demodulator 136, demultiplexer 138,

decryptor 140 and audio decompressor 142). Through the use of the hardware as configured in Figure 12b, the subscriber can select a digital audio program for listening. The subscriber can accomplish such selection through a subscriber interface (not shown), which may exist at the set top terminal 220 or, alternatively, at the Level D hardware upgrade.

The Level D hardware upgrade allows the subscriber separate access to the digital radio channels while other programming (not necessarily radio) is being viewed on the television. Typically, this upgrade would be used for digital radio usage in a separate room from that of the television. The upgrade has a separate tuner, decompressor, and visual display. In the preferred embodiment a second remote control (which is preferably a scaled-down version of the set top terminal remote control, described below) is provided to access the digital audio system. This remote is equipped with a display.

The Level E hardware upgrade allows the subscriber to download large volumes of information from the operations center 202 or cable headend 208. The Level E hardware upgrade will enable subscribers to download data, such as books and magazines, to local storage. Primarily, the Level E hardware upgrade is an additional local storage unit (e.g., hard disk, floppy, optical disk or magnetic cartridge). Preferably, a small portable reader, called "EveryBook™", is also provided with the upgrade to enable downloaded text to be read without the use of a TV. The portable reader is equipped with a screen.

The downloadable information may be text or video supplied by the operations center 202 or cable headend 208. With this upgrade, books may be downloaded and read

anywhere with the portable reader. Using this upgrade, video may be downloaded and stored in compressed form for later decompression. The video would be decompressed only at the time of viewing. Important text that the public desires immediate access may made available through this system. Text such as the President's speech, a new law, or a recent abortion decision rendered by the Supreme Court may be made immediately available.

Using a more sophisticated port, such as the SCSI port, multiple hardware upgrade units may be connected, or "daisy-chained" together, to operate simultaneously. Although these upgrade units are described separately, the units may be combined or built into the set top terminal 220. Those skilled in the art will recognize variations on such combinations of and additions to the set top terminal hardware.

d. Expansion Card Slot

In order to provide the greatest flexibility possible and prevent a set top terminal 220 from becoming outdated during the terminal's useful life, additional electronic expansion card slots have been built into the preferred embodiment. The expansion slots 665 (depicted in phantom in Figure 5b) are covered by the metal plate cover 664 as shown in Figure 5b. It is anticipated that additional memory or capabilities may be needed for certain customer features and also to update the system as the cable delivery system's capabilities increase.

In addition to providing an additional memory capability, the expansion card slot provides an easy method to upgrade the set top terminal hardware. In particular, expansion cards can be used to internally provide any of the Level A through E hardware upgrade features described above.

Such embodiments, however, use the upstream data transmission hardware, also described above (or built-in modem).

Functionally, the expansion card (not shown) may be inserted into an expansion card slot 665, causing the connector on the expansion card to electrically link with a connector on the set top terminal 220. Preferably, the frame of the set top terminal has a shelf or rack position to hold the expansion card. The connector on the set top terminal 220 may simply be an electrical connection to the set top terminal's microprocessor and/or memory device or devices. Alternatively, the interface between the expansion card and the set top terminal 220 may be an electrical bus that allows the memory resources of the set top terminal 220 to be directly expanded. In this case, the expansion card itself contains a memory device or devices that expand the amount of program information or data that the set top terminal 220 may access. Such memory devices include RAM, ROM, EPROM or EEPROM. In addition, the interface may be a "mailbox," which resides in the set top terminal 220 as a single memory location. This embodiment facilitates the transfer of data between the set top terminal 220 and the expansion card in either serial or parallel format. Such transfers are coordinated and controlled by the set top terminal's microprocessor 602.

The use of expansion cards lowers the cost of the set top terminal 220 itself, while also increasing its potential functionality. Thus, an expansion card may include enhanced functional capabilities described as part of the upgrade module discussion above and be designed to accommodate any hardware upgrade compatible with the set top terminal 220.

3. Remote Control and Subscriber Access of Set Top Terminal

The subscriber can access programs televised by the system through the set top terminal 220 using a remote control 900. Figure 13a shows a two-section remote control 900 that accommodates such access. To reduce costs and make the set top terminal 220 as user friendly as possible, a standard television remote control 350, such as a Jerrold RC 650 remote control or the like, may be augmented by adding a new section 352 that provides the additional digital menu access and ordering functions. Figure 13a depicts the addition of menu access and cursor movement control to the remote control 900.

The remote control 900 has an ordering button 354 and four-way cursor movement 356 that includes a "go" button 358 and menu access buttons 360. The preferred remote control 900 operates using infrared (IR) signals, with the signals being received by the infrared (IR) sensor 630 on the front of the set top terminal 220.

In the simplest embodiment, the remote 900, may be built with only cursor movement and a go button. In more sophisticated embodiments, the remote control 900 may be provided with buttons that are programmable to perform specific functions for a series of entries. An intelligent or smart remote control 900 would increase both the cost and capability of the set top terminal 220 system. Using the augmented remote control 900 depicted in Figure 13a, a subscriber can navigate the program menu system of the set top terminal 220.

Figure 13b shows an alternative and preferred embodiment of the remote control 900 for use in the present invention. Standard television receiver remote control

switches or buttons 362 may be used, including volume control, channel select, power and signal source buttons, as well as other menu buttons 364, including cursor movement, cursor select, menu select, and pay television buttons arranged longitudinally on the remote control 900, as opposed to the width-wise separation, as shown in Figure 13a. The color of the buttons or the surrounding background may differ between the standard television remote control buttons 362 and the menu buttons 264 to differentiate visually between these two groups of buttons.

The width and depth of the remote control unit 900 are considerably less than the length to allow the remote control unit 900 to fit easily within a user's palm. The remote control unit 900 preferably has its center of mass balanced substantially near the longitudinal middle. This balance allows a user's thumb to naturally be placed in substantially the middle portion of the remote control unit 900, when it is picked up by a user.

Since the center of mass of the remote control unit 900 is placed substantially near the longitudinal middle of the remote control unit 900 (thereby having a user's thumb naturally fall in this same center region), the standard remote buttons 362 and menu access switches or buttons 364 most frequently accessed and depressed by a user are placed in the central region of the remote control unit 900 within easy reach of the user's thumb. Channel and volume increment and decrement buttons 366 are placed near this center of mass and longitudinal center line. The channel buttons 366 are preferably beveled in opposing directions to allow a user to feel for and press a desired button without looking down at remote 900. Similarly, the volume buttons 368 are preferably beveled in opposing directions for the same reason.

Additionally, the channel buttons 366 could have a surface texture different from those of the volume buttons 368 to allow even easier differentiation.

Also placed in the longitudinal center, within easy reach of a user's thumb, are cursor movement buttons 370 and a "go" button 372. The "go" button 372 selects an option corresponding to the placement of the cursor. As opposed to buttons, a joystick may be used with a selection on the stick, or a trackball, depressible for selecting a desired choice. The cursor buttons 370 are placed ninety degrees apart, with the "go" button 372 placed within the center of the cursor movement buttons 370, as shown in Figure 13b. The cursor movement buttons 370 are preferably beveled inwardly toward the "go" button 372 and the "go" button 372 is recessed below the level of the cursor movement buttons 370 so that it is not accidentally pressed while depressing the cursor movement buttons 370. In addition to the beveling on the cursor movement buttons 370, these buttons may also have a surface texture to allow a user to feel for and select the appropriate button without looking down at the remote 900 and directional arrows could be raised or recessed on the surface of the cursor movement buttons 370 for this same purpose.

Menu select buttons 374 are placed near buttons 370 as shown in Figure 13b. Menu select buttons 374 are preferably the largest buttons on the remote control unit 900. Menu select buttons 374 preferably have icons or other graphics imprinted on their top surface or adjacent to corresponding buttons. For example, a button for the sports major menu may contain a baseball icon. The icons represent the programming available on the particular major menu selected by the menu select buttons 374. The icons may also be raised

above the level of the menu select buttons to provide a textured surface. This textured surface would allow a user to select an appropriate menu button 374 by feel, without looking at the remote control unit 900. The icons would require substantial differences in texture, while still providing a meaningful graphic related to the associated menu.

As shown in Figure 13b, labels and icons are provided for the following major menus: movies, sports, children's programming, documentary/news, entertainment, magazines, programming guide, HDTV (high definition television), interactive TV, music, and an additional button 376 for further programming. Menu select buttons 374 may also be labeled A through J for the above programs, with the last button for all additional major menus labeled K-Z.

Although the remote control unit 900 is described with a variety of channel selection buttons, nearly all buttons from a standard remote control (section 362 buttons) could be eliminated. The present invention would allow a subscriber to use a remote control unit 900 containing only menu select buttons 374 and/or cursor movement and select buttons, 370, 374, respectively.

As used herein, "button" is contemplated to include all manner of switches or touch sensitive circuitry to activate a particular function in the remote control unit 900. Additionally, although the remote control unit 900 communicates with the set top box by means of infrared transmission, other forms of communication are contemplated, including ultra-sound, radio frequency and other electromagnetic frequency communication.

4. Advanced Features and Functional Capabilities

a. Overview

In the preferred embodiment, the set top terminal 220 will include features that are now being adopted in the industry, including parental controls and locks, electronic diagnostics and error detection, muting, on-screen volume control, sleep timer, recall of last selection, etc. Each of these features has a corresponding menu (or overlay menu) that allows on-screen customizing and activation of the feature.

The preferred set top terminal 220 also supports a number of advanced features and functional capabilities. This set top terminal 220 provides subscribers with a picture-on-picture capability without requiring a special television to support the capability. The set top terminal 220 also supports a program catalogue Service, which provides subscribers with information on all programming available at its particular subscriber location. The set top terminal 220 further includes the capability of querying viewers to establish, among other things, favorite channel lists, personal profile data and mood information. The set top terminal 220 allows the subscriber to view promotional menus on future programming events.

The set top terminal 220 supports additional capabilities using its hardware upgrades that allow subscribers to use other interactive services, for example, to engage in on-line question and answer sessions, to order and confirm airline tickets, and to access a variety of other data services. The set top terminal 220 makes use of a digital tuner as a hardware upgrade to provide subscribers with a digital audio capability.

The preferred set top terminal 220 may be used to control video tape machines, thereby simplifying the recording of programs. The set top terminal 220 can, in conjunction with the program delivery system, easily support high definition television (HDTV). For subscribers living in remote locations, the set top terminal 220 accommodates backyard satellite systems.

In addition to all the features that the set top terminal 220 supports with its current internal programming and upgradeability, additional features may be added or existing features increased through remote reprogramming of the set top terminal 220. Utilizing the resident operating system on the read only memory (ROM), the cable headend 208 is able to reprogram the random access memory (RAM) of the set top terminal 220. With this capability, the cable headend 208 can remotely upgrade software on the set top terminals 220.

Reprogramming will occur by using the program control information signal, with the appropriate signals sent over this signal. In an alternative embodiment, one channel is dedicated for the special programming needs. When reprogramming is to occur, the cable head end will send an interruption sequence on the program control information channel that informs the set top terminal 220 that reprogramming information is to follow.

b. Picture-On-Picture Capability

Although the preferred embodiment of the present invention decompresses one channel at a time for the viewer, users who desire a picture-on-picture capability can be provided with a set top terminal 220 have upgraded hardware components that allow two channels to be tuned and decompressed at any given time. Once two signals are available, the picture-on-picture capability can be made fully

available in the set top terminal 220, without requiring a special television.

Figure 15 diagrams one embodiment for implementing the picture-on-picture capability. Such implementation necessarily requires the use of two tuners 603, 603' and two decompressors 618, 618' so that two separate video programs may be displayed simultaneously on the subscriber's television screen. As shown in the figure, the CATV input signal is received by the set top terminal 220 and input into two separate tuners. These tuners will each tune to a separate television program, both of which will be simultaneously displayed on the subscriber's television. The two television programs are extracted from the CATV input signal by the two parallel signals paths depicted in Figure 15.

Each signal path is substantially identical (therefore the components thereof are commonly numbered, with callout numbers of the components of one path carrying the prime indicator) and thus, only one path will be described. Each signal path shown includes a tuner 603, a demodulator 606, a demultiplexor 609, a decryptor 600 and various decompression devices. As the respective signals pass through these devices, the microprocessor 602 coordinates the signal processing to produce a decrypted program signal. The decrypted program signal is further partitioned between audio, on the one hand, and video, graphics and text, on the other. The audio signals extracted are passed to an audio decompressor 612, which further processes the audio for output to the subscriber's television.

The embodiment diagramed in Figure 15 shows only single audio channels for each video channel tuned by the individual tuners. As described above, the number of audio channels will typically include four audio signals

corresponding to a single video channel. At least two of these audio signals may be used for stereo television play. Although the subscriber can view two separate video pictures simultaneously through the picture-on-picture capability, the subscriber's television can only accommodate a single audio signal at a time (or two audio signals for stereo audio reception). Thus, the set top terminal hardware shown in Figure 15 must also include a switch (not shown), which accommodates the simple switching between each audio signal or signals that correspond to one video picture or another. Such an audio switch, which is a component well known in the art, allows the subscriber to listen to the audio of one picture or the other. The video, graphics and text portion of the program signal are routed through another demultiplexor 314, which, in turn, separates all video, graphics and text of the signals. These signal parts are stored in a memory device 620 within the set top terminal 220. This memory device may be a ROM, RAM, EPROM, or EEPROM.

The microprocessor 602 initiates and coordinates further decompression of the video, graphics and text for each of the program signals. Once these signal parts are decompressed within the set top terminal 220, these components are passed to a video combiner 316. The video combiner correlates and combines the video, graphics and text of the two program signals. The video combiner outputs these two signals for display on the subscriber's television. These signals may also pass through an NTSC encoder 625 to produce analog NTSC video waveforms, which may likewise be displayed on the subscriber's television. Such display necessarily requires that each signal pass through an RF modulator 605 in order to be input into a television. In this

way, two separate RF video outputs are produced. Each video signal produced by the RF modulators has its own corresponding audio outputs produced by each audio decompressor.

Each video signal (and its corresponding audio signal) produced by the two tuner configuration can be simultaneously displayed on the subscriber's television, which has a picture-on-picture capability, or, alternatively, the set top terminal 220 itself can create the picture-on-picture image for display. Such display involves the scaling and repositioning of one of the video (and audio) signals so that both pictures produced can be viewed simultaneously. In so doing, the subscriber's television can display one of the pictures as a full screen display, with the other picture being displayed as a scaled and repositioned display overlayed on the full screen display. To implement such a technique, the set top terminal 220 must include the hardware components necessary to produce a picture-on-picture capability, including hardware capable of scaling, repositioning and overlaying images. Such an advanced set top terminal 220 allows the subscriber to make use of a picture-on-picture capability even though the subscriber's television cannot alone produce such a result.

c. <u>Program Catalogue Service</u>

Referring to Figure 15 and to Figure 8, in the preferred embodiment of the present invention, program catalogue menu 1100 listing programs available on network schedules, will be available as a major menu of the type shown as 1020. In the preferred embodiment, the major program catalogue menu 1100 would offer submenus, such as network schedules for the next seven days, today's network schedules for the

next six hours, and TV program catalogue picks for the next seven days.

In order for the set top terminal 220 to provide a program catalogue service, the set top terminal 220 must receive information on all programming available at its particular subscriber location. This information will be sent to each set top terminal 220 as part of the program control information signal or STTCIS. The program control information signal would include, among other things, all programming scheduled for the next 7 days. This programming information would, for example, include the name of each program, the type of program, the program start time, the length of the program, the date the program will be shown, a brief description of the program and whether or not the program is closed-captioned, among other information.

All programming information sent to the set top terminal 220 for use with the program catalogue service will be stored in the set top terminal's internal memory. Upon selection of the program catalogue service by the subscriber, the microprocessor accesses the memory device during its menu generation and creation process. In this way, the programming information will be combined with the rogram catalogue menu or submenu template to produce the Program catalogue service. The program catalogue service may involve the use of more than one menu, especially where the network scheduling information covers time frames longer than a few days.

If the particular set top terminal 220 has been subscribed to the program catalogue service, the subscriber may proceed to a submenu showing schedules of programs. If the subscriber chooses the network schedule submenu 1102,

he is offered a list of network schedules to choose from. If a subscriber were to choose, for instance, HBO, an HBO-specific submenu (not shown) would appear and allow a subscriber to choose a date of interest to see what programs are available on that particular date.

d. Querying Viewer

To support a variety of services, the set top terminal 220 is capable of querying the viewer and recording viewer responses. For example, in order for the set top terminal 220 to establish a favorite channel list as shown at 1100 in Figure 16a depicting the broadcast TV menu 1112, menus querying the subscriber and allowing the subscriber to input his selection of eight favorite channels is displayed.

After querying the subscriber for a list of popular shows the terminal displays a submenu allowing the subscriber to choose one of the subscriber's favorite or popular shows for viewing. Although various embodiments of menus are possible, the goals of each are the same -- to eliminate or augment printed guides to television programs. In an alternative embodiment, a program viewing suggestion feature is available as an additional feature. This feature gives the indecisive or lazy viewer suggestions as to which programs the viewer should watch. The set top terminal 220 uses a matching algorithm to accomplish this program suggestion feature. This program suggestion feature is described in detail in co-pending patent application Serial NO. __________, entitled, REPROGRAMMABLE TERMINAL FOR SUGGESTING PROGRAMS OFFERED ON A TELEVISION PROGRAM DELIVERY SYSTEM, incorporated herein by reference.

In order for the set top terminal 220 to make decisions on which programs the subscriber should watch, the terminal

must create a personal profile for the particular viewer. From the data in the particular viewer's personal profile and the television program information available in the program control information signal, the set top terminal 220 is able to select a group of programs which the particular viewer is most likely to watch.

In order for this feature to operate, a personal profile for each viewer can be gathered by the set top terminal 220 and stored in a memory file. The personal profile consists of demographic information that may be gathered in a number of ways. The set top terminal 220 builds the personal profile for each viewer and stores the information in a memory file by viewer name. To build a personal profile in the preferred system, the viewer answers a series of questions presented on a series of menu screens. These personal profile screens request the viewer to input information such as name, sex, age, place of birth, place of lower school education, employment type, level of education, amount of television program viewing per week, and the number of shows in particular categories that the viewer watches in a given week such as, sports, movies, documentaries, sitcoms, etc. Any demographic information which will assist the set top terminal 220 in targeting advertisements to the viewer or suggesting programs may be used.

Once a personal profile has been created (in a particular set top terminal 220), it can be indefinitely stored in nonvolatile memory. A selection at the home menu screen 1010 (Figure 8) activates the program selection feature. Following activation of the feature, the set top terminal 220 will present the viewer with a series of brief questions to determine the viewer's mood at that particular time, as shown in Figure 16b. For example, the first mood question

screen 1114 may ask the viewer to select whether the viewer desires a short (30 minute), medium (30-60 minute), or long (60 plus minute) program selection. The second mood question screen 1116 requests the viewer to select between a serious program, a thoughtful program, or a light program, as shown in Figure 16c. And the third mood question screen 1118 requests whether the user desires a passive program or an active program, as shown in Figure 16d. The viewer makes a selection in each question menu, utilizing the cursor movement keys and "go" button on the remote control unit 900.

After the viewer has responded to the mood question menus which determine his mood, the set top terminal 220 uses the personal profile information and mood information to find the best programming matches for the viewer. The set top terminal 220 displays an offering of several suggested programs to the viewer. With this program selection feature, the set top terminal 220 can intelligently assist the specific viewer in selecting a television program.

The personal profile information may also be used in targeting advertisements. In the preferred embodiment, the network controller 214 can target specific advertisements to individual cable distribution network nodes or, alternatively, to individual subscribers. In order to accomplish the advertisement targeting capability, the network controller 214 transmits packages of advertisements to the cable distribution network nodes or subscribers for eventual display on the set top terminal 220. When the video that the subscriber is watching nears a break for a commercial, a specific advertisement or set of advertisements is specifically targeted to a particular set top terminal 220 based on the personal profile information described above. Although the

network controller 214 is the component in the program delivery system which provides this targeting capability, the set top terminal 220 accommodates transparent channel switches to display the targeted advertisement. In this way, although the subscriber thinks that the set top terminal 220 is tuned to a specific channel, an advertisement from another channel is displayed on the subscriber's television.

The hardware required to accommodate such transparent channel switching capabilities are shown in Figures 17a and 17b. Figure 17a shows the set top terminal hardware components which accommodate channel switching within a single 6 MHz channel bandwidth. These components include a tuner 603, a demodulator 606, a demultiplexer 609, a multiplexer 400, a decompressor 622, a microprocessor 602, and local memory M. The tuner 603 operates by tuning to a specific 6 MHz bandwidth which includes the displayed video and a number of channels carrying advertisements. The demodulator 606 processes these signals and sends them to the demultiplexor 609, which converts the received signal into separate program and advertisement signals. During this processing, the microprocessor 602 coordinates the demultiplexing of the programming signals. Once the video signal pauses for a commercial break, the microprocessor 602 instructs the multiplexer 400 to select the advertisement or advertisements for decompression and subsequent display on the subscriber's television. This hardware configuration allows the set top terminal 220 to switch between channels within the 6 MHz bandwidth and display various advertisements for viewing, regardless of the video currently being watched by the subscriber.

Where a targeted advertisement falls outside the tuned 6 MHz bandwidth containing the video that the subscriber is currently watching, the hardware configuration shown in Figure 17b is used. In this configuration, the microprocessor 602 instructs the tuner 603 to retune to another 6 MHz channel bandwidth, as represented by bi-directional arrow A.

Working together, the microprocessor 602 and tuner 603 allow targeted advertisements, which have been transmitted in another 6 MHz bandwidth, to be tuned with minimal acquisition time and delay. In particular, this configuration allows the set top terminal 220 to tune outside a given 6 MHz bandwidth (to another 6 MHz bandwidth) in order to select a targeted advertisement for display. This alternative embodiment may require the use of a full screen mask in order to minimize any annoying screen rolling during the tuning process. The masking is intended to cover any glitches which would otherwise be displayed during the acquisition time (e.g., 0.5 seconds) for retuning to another 6 MHz channel bandwidth.

Where the acquisition time or delay becomes unreasonable, an alternative embodiment (not depicted) can include the use of two tuners similar to the configuration used above for the picture-on-picture capability. This alternative configuration using two tuners trades an increased cost for lower acquisition times. Those skilled in the art will recognize a number of other configurations of set top terminal hardware that will accommodate a transparent channel switching feature. A more detailed description of target advertising and channel switching is provided in patent application Serial No. _____, entitled, NETWORK CONTROLLER FOR CABLE TELEVISION DELIVERY SYSTEM, incorporated herein by reference.

e. Promotional Menus

Figure 18 depicts the use of a promotional menu 1120 used to sell subscriptions to services in the system 200. This promotional menu is tailored to Level B interactive services which include a variety of on-line type services such as Prodigy, Yellow Pages, Airline Reservations, etc. A similar menu is used for Level A interactive services that offers subscribers additional information about programs such as quizzes, geographical facts, etc. Such information may be received by the set top terminal 220 in several data formats, including in the vertical blanking interval (VBI) and in the program control information signal.

Other promotion menus similar to menu 1120 may be used for the Level C interactive services. The Level C interactive services utilize local storage such as CD technology (e.g., 122) to offer an enormous range of multi-media experiences. The Level C interactive services require a hardware upgrade as described earlier. Specially adopted CD-I and CD-ROM 122 units are used for this service.

Typically, promotional menus may be generated when a subscriber selects a nonexistent channel, creating a virtual channel. Such virtual channels do not require any additional bandwidth since these channels do not carry any of the data required to create a promotional menu. Instead, when the subscriber selects a channel that does not exist (e.g., Channel 166), a virtual channel is created using data sent to the set top terminal in a number of ways. For example, the data may be sent in the vertical blanking interval (VBI) of another channel, out-of-band, or with the menu information sent from the headend 208 in the set top terminal control information stream (STTCIS). The data will be used to create graphics stored locally at the set top terminal 220 as an NTSC video

signal which may be displayed on the subscriber's television. In this way, a promotional menu may be drawn and a virtual channel is created. This capability simply provides the set top terminal 220 with the ability to display a promotional menu or graphics display whenever a nonexistent channel is selected by the subscriber.

f. Other Interactive Services

Figures 19a and 19b show menus (1130 and 1132, respectively) that are available using the interactive Level A services. Referring to Figure 19a, when interactive Levels A services are available for a television program, the system will display an interactive logo 1134 consisting of the letter "I" and two arrows with semicircular tails. In the preferred embodiment, the set top terminal 220 will place the interactive logo on the television screen as an overlay menu. In the preferred embodiment, the set top terminal 220 will detect that there is data or information available about a television program which can be displayed to a subscriber using the interactive service. When the set top terminal 220 senses that there is interactive information available, it will generate the interactive logo overlay menu 1134 and place it on the television screen. For example, the set top terminal 220 will detect that information on a television program is being sent in the vertical blanking interval (VBI) and generate an interactive logo overlay menu 1134 which will appear on the subscriber's television screen for approximately fifteen seconds during each ten minute interval of programming. Similarly, the set top terminal 220 can sense that the programming has closed caption information available and place a closed caption logo on the screen.

Referring to Figure 19b, when the subscriber sees the interactive logo 1134 on the television screen, the subscriber

is made aware of the fact that interactive services are available in conjunction with his television program. If the subscriber presses the interactive remote control button, another overlay menu 1133 will be generated by the set top terminal 220 and placed on the screen. This overlay menu 1133 is shown in Figure 19b being overlayed on an interactive television program. From this menu 1133, the subscriber may select a variety of different types of textual interactivity with the current television program, as at 1134, including quizzes, fast facts, more info, where in the world, products, etc. At any time during the interactive submenus, the user may return to the television program without interactive features.

Another submenu 1136 gives additional information related to the television program to the viewer in textual form in the lower half of the screen. In Figure 19b, the submenu 1136 shows the available interactive options for the subcategory "quiz." In this interactive subcategory, the user is presented with questions and a series of possible answers. If the subscriber desires, the subscriber selects one of the answers to the quiz question. After the selection, the set top terminal 220 sequences to another menu. The set top terminal 220 sequences to the interactive quiz answers submenu which informs the subscriber whether the correct answer was or was not chosen. Subsequently, another submenu would show correctly or incorrectly answered quiz question.

Figure 20a is an example of a submenu for Level B interactive services. From this menu screen 1141, any of a number of on-line data services could be accessed. One service, the airline reservations selection 1142, has been chosen by the subscriber on this menu.

In selecting airline reservations, the subscriber encounters a sequence of menus as for any on-line data service. Referring to Figure 20b, the subscriber is typically shown a submenu, such as submenu 1144, for the data service offering various options. In each of these submenus related to a data service, the subscriber is able to exit, returning to the home menu 1010 or regular cable TV.

Figure 20b, the airline information and reservation submenu 1144, allows a subscriber to view six available flights. A subscriber may select one of the flights to check on its availability. Another similar submenu allows a subscriber to enter the month, day and year for the availability date desired. In this submenu, the subscriber is offered the option of correcting any errors in the entered information.

Figure 20c is another airline submenu 1150 that allows a subscriber to view remaining seats available on a flight, enabling the selection of a seat assignment. This interactive submenu 1150 is an example of how information may be graphically shown to a subscriber using a portion of the menu and different coloring schemes. In this interactive menu, the lower half of the screen 1152 shows the passenger compartment of an airplane with all the seat locations graphically represented by square blocks. By coloring the available seat locations in blue and the unavailable seat locations in a different color, the menu can present a great deal of information in a limited amount of space. This graphic presentation of information for the interactive on-line data services is an important method of visually displaying large amounts of information to the subscriber.

Referring to Figure 20d, another submenu 1156 allows the subscriber to choose a one-way or round-trip ticket, to confirm reservations and to charge an airline ticket by credit

card, choosing the appropriate strip menu on the lower part of the screen. In this particular menu 1156, the subscriber is charging a round-trip plane ticket on a credit card. The subscriber simply needs to enter the credit card number, expiration date, and credit card type to charge an airline ticket. Other submenus may process the subscriber's credit card charge for the airline ticket, confirm the subscriber's airline ticket purchase, and pass this information to the location where the ticket is printed.

Using the methods and hardware described, a variety of interactive services are possible. Those skilled in the art will recognize that such interactive services may be accommodated by the preferred set top terminal 220.

g. Caller ID

Using the capability of the set top terminal and a connected modem, the set top terminal is able to perform the function of caller ID. The caller ID function of the set top terminal assists the viewer in a manner similar to the caller ID function provided by telephone companies. However, the set top terminal is able to use the television as its display means to communicate to the viewer information about incoming telephone calls. Also, the strong local processing capability of the set top terminal allows the caller ID function to be much more user friendly and convenient.

If the set top terminal senses that a viewer is using the system and watching television, then the caller ID feature would automatically be activated. When the caller ID function is active, the set top terminal software will monitor incoming telephone calls to the viewer through the modem. After the set top terminal senses that the phone is ringing, signals are received on the tip and ring lines of the telephone, the system will immediately look for incoming telephone data

identifying the telephone number from which the telephone call was initiated.

Upon receiving the telephone number from which the call was initiated, the preferred embodiment of the caller ID compares the telephone number with a list of telephone numbers stored in memory. The list of telephone numbers stored in memory is cross referenced to a list of names, other textual data or graphics. When the set top terminal finds a match between the telephone number and a number stored in memory, the corresponding text or graphics are displayed on the television screen. For example, "GRANDMA" and a "smiley face" graphic can be flashed across the television screen using an overlay menu.

In this manner the viewer may see the name (and identifying icon graphics) of the person placing the call and can decide whether to activate an automatic telephone message recording system or answer the telephone call. After generating an overlay menu, the set top terminal software awaits an IR command signifying a viewer response. With the simple depression of a button on the remote control, the viewer can instruct the set top terminal to send an activation signal to the automatic telephone message system (through a set top terminal port). Thus, the viewer can continue to watch a program and know the identity of a caller without taking his or her eyes off the television. If a dumb telephone message system is used, the viewer can simply allow the telephone to ring the requisite number of rings until the telephone answering machine normally activates and answers the call.

In an alternative embodiment, having no stored telephone numbers, the set top terminal may just flash the incoming telephone number on the screen using an overlay

menu. In a more sophisticated embodiment, a microphone is provided in the set top terminal or remote control unit. Using the television's speakers, a remote control, and a microphone, the viewer is able to answer the telephone using the keys of the remote control without taking his or her eyes off the television screen.

h. Digital Audio Capability

Referring to Figure 21, the digital audio feature of the invention allows a subscriber to listen to CD quality audio selections through the subscriber's stereo (not shown). This can be accomplished by running cables directly from the set top terminal 220 (which may include a Level D hardware upgrade) to the subscriber's amplifier/stereo system. Alternatively, the subscriber may listen to audio selections through the subscriber's television system.

In the preferred embodiment, the digital audio feature uses a Level D hardware upgrade as a digital radio tuner. This Level D hardware upgrade enables a subscriber to use the program delivery system's digital audio signaling capability. Digital audio transmissions require much less bandwidth than that used for the transmission of a digital video signals. Thus, hundreds of digital audio programs are delivered to each set top terminal 220 in limited segments of bandwidth.

Where digital audio programs are delivered to the set top terminal 220, the Level D upgrade (shown in Figure 13b) provides the subscriber with the means to select a given digital audio program for listening. The Level D hardware upgrade makes use of a tuner 603 that is separate from the tuner 603 used by the set top terminal 220 for video display. The digital audio signal is received at the set top terminal 220 over the CATV transmission media. The set top terminal 220, in turn, routes the digital audio signal to the

components of the Level D hardware upgrade. These components may include: a tuner 603, demodulator 606, demultiplexer 609, decryptor, decompressor 622, remote control interface and microprocessor 602.

The Level D hardware upgrade will use its tuner 603 to tune to the specific digital audio program selected by the subscriber and subsequently demodulate, demultiplex and decrypt the digital audio signal. Upon completion of this processing, the digital audio signal will be decompressed to produce a processed digital audio signal ready to be output to the subscriber's stereo or directly to speakers.

The Level D hardware upgrade includes ports for the digital audio signal output, which provide the necessary connections for transmission of the signal from the Level D hardware upgrade to the subscriber's stereo. In addition, the Level D hardware upgrade include a small LED display that can show the channel number of the program selected, date and time, among other display fields.

The Level D hardware upgrade can be physically located in a different room from that of the television and set top terminal 220. Thus, the Level D hardware upgrade will have its own remote control device (not shown), albeit with less available options and keys than the set top terminal's remote control 900 described above. This Level D hardware upgrade remote control is more limited than the set top terminal's remote control 900 since the Level D remote control will be used exclusively for digital audio program selection. This limited remote control, nevertheless, includes a small LED or LCD display that is used to display the channel number of the digital audio program selected. Alternatively, the set top terminal's remote control may be programmed for use with

the Level D hardware upgrade so that an additional remote control is not required to use the digital audio feature.

Using either remote control embodiment, the subscriber accesses the Level D hardware upgrade to select a digital audio program. The remote control sends an IR command signal to the Level D hardware upgrade, instructing the unit's microprocessor 602 to initiate the selection of a given program. The desired program is processed (i.e., tuned, demultiplexed, decrypted and decompressed) as described above and transmitted to the subscriber's stereo for listening.

The selection of a digital audio program does not necessarily require interaction with the subscriber's television. Instead, all communications required to select a digital audio program may occur between a remote control and the Level D hardware upgrade. As a result, the subscriber's television need not be turned on for the digital audio capability to operate.

Alternatively, the Level D hardware upgrade can be co-located with the set top terminal 220 and the subscriber can select a digital audio program through a menu displayed on the subscriber's television. In this embodiment, the subscriber would use the set top terminal remote control to access a digital audio program selection menu.

In an alternative embodiment, the set top terminal 220 includes all the features of the Level D upgrade and, therefore, no upgrade is necessary. Those skilled in the art will recognize other alternatives that allow digital audio reception.

Figure 21 is a major menu 1160 displaying the digital audio program choices which are available for subscribers who have paid the monthly fee. In a chart format 1162, the

major menu shows the top five, ten, and forty songs available in six different categories of music. Below the chart, the system is able to provide a text message 1164 describing the particulars of the audio program selected. Using the same logos and menu format, the system can provide a text description enticing the subscriber to pay the monthly fee and join the service. For example, one menu may allow the user to test the system with a free demonstration. Another menu allows the subscriber to request additional promotional information about the system. Such menus may be used throughout the menu system. From any of the menu screens for the digital audio feature, the subscriber may return to regular cable TV with the press of a single button.

i. VCR Control

Referring to Figure 22, the advanced system of the set top terminal 220 is used to control video tape machines and simplify recording programs using a Guide Record feature. The set top terminal 220 has a separate output 650 for a VCR. Control signals are transmitted through the VCR output of the set top terminal 220 and input to the VCR to allow the VCR to be automatically controlled by the set top terminal 220. Using the set top terminal 220, certain programs are selected by a subscriber from menus, and the VCR will be automatically activated to record the selected program.

In order to accommodate the VCR control feature, the set top terminal 220 sends instructions or control signals to the VCR. Such control signals are initiated by the set top terminal's microprocessor 602 and passed to the VCR either using a separate connection or as part of the video signals processed for display on the subscriber's television. These control signals are sent directly from the advanced set top

terminal 220 to the VCR, instructing the VCR when to begin and end taping of a particular program.

The microprocessor 602 coordinates the dissemination of control signals sent to the VCR, storing the content of such signals in local memory. Upon nearing the time for the program to be displayed, the microprocessor 602 activates the menu generation software to display a notification menu or screen, notifying the subscriber that the program is nearing the time for display. This reminder will also request the subscriber to check whether a tape has been inserted into the VCR itself.

The subscriber can initiate the VCR control feature by accessing a VCR control submenu, which requests whether the subscriber wishes to record a program selected for future viewing. In this way the subscriber interactively enters such information on the menu screen or display using any of the hardware described above that accommodates subscriber interactive response capabilities.

In the preferred embodiment, the subscriber will use a movie library in conjunction with his VCR or other video taping machinery. The movie library is a menu selectable list of available movies. In that way, a subscriber may tape movies which are shown at inconvenient start times for later viewing. By enabling the proper features of the set top terminal 220, a subscriber can have the terminal activate the television and the VCR and perform all the functions necessary to tape a movie.

After the VCR control feature is initiated, a menu screen confirms the movie selection, start date and start time and informs the subscriber that the VCR will be automatically turned on. During this submenu, the user may return to the movie library major menu, or regular TV or cancel the movie

library order by pressing the escape button. This menu shows that the subscriber has chosen to return to regular TV. The subscriber's VCR or other video taping equipment must be connected to the set top terminal 220 for the automatic taping feature to operate.

Following a program choice, a program description submenu is placed on the television screen. In addition, from this program description submenu, the viewer may choose to record the selected program on his VCR using the guide record feature. If the guide record feature is chosen, the guide record submenu 1170 shown in Figure 22 provides the subscriber with further instructions. In order for the set top terminal 220 to perform the guide record functions and operate the VCR, control signals are sent from the set top terminal 220 to the VCR via the video connection 650 or through a separate connection between the set top terminal 220 and the VCR. The VCR is capable of interpreting these control signals from the set top terminal 220 and performing the desired function (such as, activating the record feature). In the preferred embodiment, the VCR control signals are sent with the video signal and output from the output 650, as described above. Alternatively, a separate connection between the set top terminal 220 and VCR may be used.

j. <u>HDTV Capability</u>

The set top terminal 220 and program delivery system of the preferred embodiment can easily support high definition television (HDTV). The combination of digital video, compression and no restricted bandwidth limitation per channel makes the preferred system ideal for HDTV. The greater information flow of HDTV causes no problems for the system. The menu selection system of the preferred

embodiment is a user friendly manner of presenting HDTV programming to the subscriber.

Figure 23 shows the integration of HDTV services into the menu-driven program delivery system. If the subscriber selects the major menu for HDTV 1032, the subscriber will receive either a description of the service with a suggestion to order the system, or a text note that the subscription is current and a listing of the currently available program selections in HDTV. If the subscriber has not paid to join the particular service, HDTV, the subscriber may be allowed to join one of the programs in progress for a limited time as a demo to entice the subscriber to order.

If a subscriber has paid the HDTV fees, the subscriber proceeds as in any other major menu screen. This particular major menu shows an example of how a follow-on or second screen may exist for the same menu. In this particular case, a second screen exists for the major menu HDTV 1032. The subscriber may access the second screen by selecting the last menu display block 1172 "Other HDTV Selections" in the lower part of the screen. Following this selection, the subscriber will be given a second screen of program selections. In this manner, any menu can have multiple screens with many program choices. This type of screen pagination on one menu allows the operations center 202 packager to avoid categorizing program selections within that same menu. In an alternative embodiment, the options available to the subscriber may be scrolled on one menu screen with the text within the menu display blocks changing as the subscriber scrolls up or scrolls down. Many variations of this HDTV example can be used with the described system.

k. Backyard System

In an alternative configuration, in areas without cable services where subscribers use backyard satellite systems (TV RO) to receive packaged television services, the set top terminal 220 will include the appropriate hardware to allow connection to the satellite 206 reception equipment through port 656. In this configuration, the menu system within the set top terminal 220 will be programmed directly from the operations center 202. Additionally, an upstream communication mechanism must be in place at the subscriber's home (i.e. modem) to communicate information to the operations center.

The hardware components that allow the set top terminal 220 to operate in a backyard system typically will not be included within the set top terminal shell itself. Instead, any such components accommodating the set top terminal's interoperability with a backyard program delivery system will typically reside outside the subscriber's home. As a result, the set top terminal 220 will operate as described above, notwithstanding any change in program delivery transmission media.

The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. Those skilled in the art will recognize that numerous variations are possible within the spirit and scope of the invention as defined in the following claims.

CLAIMS

What is claimed is:

1. An upgrade module for enhancing the functionality of a decompression box for use in a cable television program delivery system, the enhanced functionality using a control information stream that provides the decompression box with menu generation capability, the decompression box initially having the capability to produce decompressed video, the upgrade module comprising:

an interface means for providing an electronic connection to the decompression box so that the control information stream may be received from the decompression box;

a means for demultiplexing the control information stream into graphics and text;

a means for combining the text and graphics to produce a menu generation signal; and

a means for transferring the menu generation signal to the interface means for output to the decompression box, whereby the menu generation signal is processed for display.

2. The upgrade module of claim 1 further comprising a graphics decompressor for decompressing the graphics to produce decompressed graphics that may be used to generate menus.

3. The upgrade module of claim 1 for further providing the decompression box with a program catalogue that provides the subscriber with program schedules and descriptions, the decompression box providing the upgrade module with video signals, wherein the interface means

comprises a means for receiving the video signals from the decompression box and wherein the combining means comprises:

a means for interpreting the text and graphics;

a means for integrating the received video signals, the interpreted text and the interpreted graphics to produce the menu generation signal, whereby the menu generation signal carries data required for display of the program catalogue; and

a means for sending the menu generation signal to the transfer means, whereby the menu generation signal is output to the decompression box for display of the program catalogue.

4. The upgrade module of claim 1 for further enabling the decompression box to use promotional menus that provide the subscriber with promotional videos, text and graphics showing future events available for menu driven program selection, the decompression box providing the upgrade module with video signals, wherein the interface means comprises a means for receiving the video signals from the decompression box, and wherein the combining means comprises:

a means for interpreting the text and graphics;

a means for integrating the received video signals, the interpreted text and the interpreted graphics to produce the menu generation signal, whereby the menu generation signal carries data required for display of the promotional menus; and

a means for sending the menu generation signal to the transfer means, whereby the menu generation signal is output to the simple decompression box for

display of the promotional menus and the promotional videos, text and graphics.

5. The upgrade module of claim 1, wherein the menu generation capability makes use of graphics and text stored locally within the upgrade module, and wherein the upgrade module further comprises a memory means for storing the graphics and text for use with the menu generation signal, so that the menus can be generated.

6. The upgrade module of claim 1, wherein the interface means comprises at least one cable connector adapted for use with an upgrade port on the decompression box.

7. The upgrade module of claim 1, wherein the decompression box has an expansion card slot, and wherein the interface means comprises at least one card connector adapted for use with the expansion card slot in the decompression box.

8. The upgrade module of claim 1 for further providing the decompression box with a telephone caller identification message, the decompression box having a port adapted to receive telephone signals from a telephone line, wherein the upgrade module further comprises:

a connection means for providing an electronic connection to the decompression box for receiving the telephone signals;

a means for processing the telephone signals to produce text messages and graphics icons; and

a means for sending the text messages and graphics icons to the combining means to produce the

menu generation signal, whereby the text messages and graphics icons are used to form the menu generation signal that is transferred to the decompression box for display of the caller identification message.

9. The upgrade module of claim 1 for further providing the simple decompression box with video cassette recorder control capability that uses recording menus presenting selection options to a subscriber and video cassette recorder control signals sent to the decompression box, the video cassette recorder control signals corresponding to the selection options chosen by the subscriber, wherein the menu generation card further comprises:

a means for generating the recording menus;

a means for interpreting the selection options chosen by the subscriber and received from the set top converter through the interface means;

a means for generating the video cassette recorder control signals based on the interpreted selection options chosen by the subscriber; and

a means for transmitting the video cassette recorder control signals to the decompression box for instructing the video cassette recorder in recording of programs.

10. A hardware upgrade for enhancing the functionality of a set top converter in a cable television program delivery system, each set top converter having menu generation capability and a subscriber interface adapted to receive subscriber inputs, the hardware upgrade using interactive programming instructions to process interactive subscriber

inputs to produce processed interactive subscriber inputs, the hardware upgrade comprising:

an interface means for providing an electrical connection to the set top converter, whereby the interactive subscriber inputs are transferred from the set top converter for processing and the processed interactive subscriber inputs are passed to the set top converter for display;

a means for storing the interactive programming instructions;

a means for accessing the stored interactive programming instructions;

a microprocessing means for processing the interactive subscriber inputs to produce the processed interactive subscriber inputs based on the stored interactive programming instructions.

11. The hardware upgrade of claim 10, wherein the interface means comprises:

a means for receiving the subscriber inputs from the set top converter, wherein the received subscriber inputs include textual information that is used to produce the processed subscriber inputs; and

a means for transferring the processed subscriber inputs to the set top converter for display.

12. The hardware upgrade of claim 10 for use with on-line databases and interactive services outside of the cable television program delivery system, wherein the hardware upgrade further comprises a telephone modem adapted to provide communications capability with the on-line databases and the interactive services.

13. The hardware upgrade of claim 10 that uses digital data, wherein the hardware upgrade further comprises:

a high volume memory means capable of storing the digital data to produce stored digital data; and

a means for linking the high volume memory means to the microprocessing means, wherein the stored digital data is transferred to and received from the microprocessing means.

14. The hardware upgrade of claim 10, wherein the set top converter has an expansion card slot, and wherein the interface means comprises at least one card connector adapted for use with the expansion card slot in the set top converter.

15. A hardware upgrade for enhancing the functionality of a set top converter and television display in a cable television program delivery system, each set top converter having a subscriber interface adapted to receive subscriber inputs and to display menus, the enhanced functionality allowing reception of digital audio programs, the hardware upgrade comprising:

a subscriber interface means for subscriber selection of any one of the digital audio programs using one or more of the menus displayed with the menu generation capability;

an interface means for providing an electrical connection to the set top converter, wherein the subscriber selections are passed to the set top converter for display and wherein the digital audio programs received;

a means for processing digital audio programs; and

a means for enabling one of the digital audio programs for listening based on the subscriber selections.

16. The hardware upgrade of claim 15 for use with a frequency carrying a digital audio signal, wherein the processing means comprises:

a means for tuning to the frequency carrying the digital audio signal that corresponds to one of the digital audio programs;

a means for demodulating the digital audio signal;

a means for extracting one of the digital audio programs from the digital audio signal; and

a means for decompressing the extracted digital audio program for output to the set top converter, whereby the digital audio output occurs over the interface means.

17. An upgradeable set top converter for use in a cable television program delivery system, the set top converter initially having video decompression capability and an expansion card slot adapted to receive a menu generation card, the set top converter upgradeable for enhanced functionality that provides the set top converter with menu generation capability using a control information stream received from a remote location, the upgradeable set top converter comprising:

an interface means for providing an electronic connection to the set top converter, whereby the

control information stream is received from the set top converter through the interface means;

a means, connected to the interface means, for demultiplexing the control information stream into graphics and text, whereby the control information stream is passed to the demultiplexing means from the set top converter through the interface means; and

an expansion card interface means for receiving the menu generation card, whereby the menu generation card upgrades the set top converter for menu generation capability.

18. The upgradeable set top converter of claim 17 further comprising a graphics decompressor for decompressing the graphics to produce decompressed graphics that may be used to generate menus.

19. An upgraded set top converter for use in a cable television program delivery system, the set top converter initially having video decompression capability and an expansion card slot, the set top converter upgraded for enhanced functionality that provides the set top converter with menu generation capability using a control information stream received from a remote location, the upgraded set top converter comprising:

an interface means for providing an electronic connection to the set top converter;

a means for demultiplexing the control information stream into more than one program signal component, including graphics and text, whereby the control information stream is passed to the

demultiplexing means from the set top converter through the interface means; and

an expansion card interface means; and

a menu generation card, electronically connected to the expansion card interface means, comprising a means for combining the text, graphics and video signals to produce a menu generation signal, whereby the menu generation signal is output through the interface means to the set top converter to be processed for display.

20. The upgraded set top converter of claim 19 further comprising a graphics decompressor for decompressing the graphics to produce decompressed graphics that may be used to generate menus.

21. The upgraded set top converter of claim 19 with the enhanced functionality further providing the set top converter with a program catalogue that provides the subscriber with program schedules and descriptions corresponding to video signals, wherein the interface means comprises a means for receiving the video signals, and wherein the combining means comprises:

a means for interpreting the text and graphics;

a means for integrating the video signals, the interpreted text and the interpreted decompressed graphics to produce the menu generation signal, whereby the menu generation signal carries data required for display of the program catalogue; and

a means for sending the menu generation signal to the transfer means, whereby the menu generation

signal is output to the set top converter for display of the program catalogue.

22. The upgraded set top converter of claim 19 for further enabling the set top converter to use promotional menus that provide the subscriber with promotional video signals, text and graphics showing future events available for menu driven program selection, wherein the interface means comprises a means for receiving the video signals, and wherein the combining means comprises:

a means for interpreting the text and graphics;

a means for integrating the promotional video signals, the interpreted text and the interpreted graphics to produce the menu generation signal, whereby the menu generation signal carries data required for display of the promotional menus; and

a means for sending the menu generation signal to the transfer means, whereby the menu generation signal is output to the set top converter for display of the promotional menus.

23. The upgraded set top converter of claim 19 for further providing the set top converter with a telephone caller identification message, the set top converter having a port adapted to receive telephone signals from a telephone line, wherein the menu generation card further comprises:

a connection means for providing the electronic connection to the set top converter, whereby the telephone signals are received from the set top converter; and

a means for processing the telephone signals to produce text messages and graphics icons and for

sending the text messages and graphics icons to the combining means to produce the menu generation signal, whereby the text messages and graphics icons are used to form the menu generation signal that is transferred to the set top converter for display of the caller identification message.

24. The upgraded set top converter of claim 19 for further providing the set top converter with video cassette recorder control capability that uses recording menus presenting selection options to a subscriber and video cassette recorder control signals sent to the set top converter, the video cassette recorder control signals corresponding to the selection options chosen by the subscriber, wherein the menu generation card further comprises:

a means for generating the recording menus;

a means for interpreting the selection options chosen by the subscriber and received from the set top converter through the interface means;

a means for generating the video cassette recorder control signals based on the interpreted selection options chosen by the subscriber; and

a means for transmitting the video cassette recorder control signals to the set top converter for instructing the video cassette recorder in recording of programs.

25. An advanced set top terminal with digital decompression and menu generation capabilities for use with a cable television program delivery system having digitally compressed program signals and a control information stream carrying menu content information, each set top

terminal stores menu content information used to generate menu displays, the advanced set top terminal comprising:

a means for storing the menu content information;

a means for receiving the digitally compressed program signals and the control information stream;

a first signal processing means for processing the control information stream to produce processed control information, whereby the processed control information is used to update the stored menu content information to produce updated menu content information;

a means for generating the menu displays using the updated menu content information, whereby the menu displays produce subscriber options for selection of other menus and television programs;

a means for selecting the other menus and the television programs;

a means for tuning to one of the digitally compressed television programs signals to produce a tuned television program signal; and

a second signal processing means for processing the tuned television program signal to produce a video signal and audio signal for television display and listening.

26. The advanced set top terminal of claim 25, wherein the second signal processing means comprises:

a means for demodulating the tuned television program signal to produce a demodulated program signal;

a means for demultiplexing the demodulated program signal to produce video signal components and audio signal components;

a video decompressing means for decompressing the video signal components to produce decompressed video signal components;

an audio decompressing means for decompressing the audio signal components to produce decompressed audio signal components;

a means for combining the decompressed video signal components with the stored menu content information for television display of the video signal; and

a means for producing the audio signal from the decompressed audio signal components.

27. The advanced set top terminal of claim 26 that has a picture-on-picture capability using multiple tuners, wherein the tuning means comprises more than one tuner so that the multiple tuners can produce multiple television program signals which will be overlayed over one another.

28. The advanced set top terminal of claim 26 having a program catalogue service that provides the subscriber with program schedules and descriptions, the program schedules and descriptions created from text and graphics, the text and graphics and the decompressed video derived from the control information stream, wherein the advanced set top terminal further comprises:

a means for interpreting the text and graphics;

a means for integrating the interpreted text, the interpreted graphics and the video signal to produce a

menu generation signal, whereby the menu generation signal carries data required for display of the program catalogue; and

a means for outputting the menu generation signal for display.

29. The advanced set top terminal of claim 26 having a promotional menu display capability that provides subscribers with promotional videos, text and graphics showing future events available for menu driven program selection, wherein text and graphics are derived from the control information stream, and wherein the advanced set top terminal further comprises:

a means for interpreting the text and graphics;

a means for integrating the interpreted text, the interpreted graphics and the decompressed video to produce a menu generation signal, whereby the menu generation signal carries data required for display of the promotional videos; and

a means for outputting the menu generation signal for display.

30. The advanced set top terminal of claim 25 capable of operating with interactive services conducted from a cable headend or other remote location, the interactive services requiring entry of interactive subscriber inputs and use of interactive programming instructions, wherein the selection means comprises:

a subscriber interface means for entry of the interactive subscriber inputs;

a means for storing the interactive programming instructions;

a means for accessing the stored interactive programming instructions;

a microprocessing means for executing the stored interactive programming instructions to produce interactive signals; and

an upstream data transmission means for transmitting the produced interactive signals to the cable headend.

31. The advanced set top terminal of claim 26 having a caller identification function capable of displaying a caller identification message using a menu generation signal, wherein the advanced set top terminal further comprises:

a means for receiving telephone signals;

a means for processing the telephone signals to produce text messages and graphics icons using the menu content information;

a means for combining the text messages and graphics icons to produce the menu generation signal carrying the caller identification message for television display; and

a means for preparing the menu generation signal for television display.

32. The advanced set top terminal of claim 25 capable of processing high definition television signals, wherein the second signal processing means comprises:

a means for interpreting the high definition television signals; and

a means for preparing the interpreted high definition television signals for television display.

33. The advanced set top terminal of claim 25 capable of receiving television program signals through a backyard system having backyard digital signal processing equipment, wherein the advanced set top terminal further comprises an interface means for electrically connecting the backyard digital satellite processing equipment to the first signal processing means.

34. A remote control unit for use with a set top terminal, the set top terminal capable of receiving a plurality of digitally compressed television signals and generating a plurality of menus corresponding to the digitally compressed signals, each menu corresponding to a group of related programs or a single program, the remote control unit comprising:

means, within the remote control unit, for communicating with the set-top terminal to allow selection of a desired program by a user from the plurality of menus; and,

a plurality of switches, coupled to the means for communicating, the plurality of switches including menu select switches and cursor movement switches, the cursor movement switches being capable of causing a cursor to move on a menu;

the menu select switches being capable of selecting a desired menu from the plurality of menus, the menu switches having icons representing the groups of related television signals;

the cursor movement switches located substantially at the center of mass of the remote control unit, and each cursor movement switch having an angled surface;

whereby a user's thumb may easily access and depress a cursor movement switch or menu select switch and distinguish the cursor movement switches and menu select switches from the remainder of the plurality of switches without looking at the remote control unit.

35. The remote control unit of claim 34 wherein the plurality of switches includes two groups of switches, a standard group including the volume control and channel select switches, and a special group including the cursor movement switches and menu select switches, whereby the two groups of switches are physically separated from each other on the remote control unit by a line at or above the center of mass of the remote control unit.

36. The remote control unit of claim 34 further comprising a joystick for cursor movement.

37. The remote control unit of claim 34 further comprising a ball for cursor movement.

38. The remote control unit of claim 34 further comprising a rolling-depressible button for cursor movement.

39. An interface system with program instructions that uses button depression signals for subscriber entries for a subscriber to interface with a video and audio programming delivery system which uses digitally compressed signals, for selecting programs using a cursor on menus or menu buttons, comprising:

a portable remote control unit for accepting subscriber entries comprising:

a plurality of buttons for creating button depressions signals comprising:

cursor movement buttons for directional movement of the cursor; and

menu buttons for choosing menus; and

a means for communicating button depression signals;

a set top terminal unit for selecting programs comprising:

a means for receiving the digitally compressed signal;

a means for decompressing the digitally compressed signal into a decompressed signal;

a means for generating menus from the decompressed signals;

a means for receiving the communicated button depression signals;

a processor means, connected to the receiving means, for executing the program instructions comprising:

a means for effecting the execution order of program instructions using the button depression signals; and

a means for sequencing through the generated menus.

40. A method for enhancing the functionality of a decompression box for use in a cable television program delivery system, the enhanced functionality using a control

information stream that provides the decompression box with menu generation capability, the decompression box initially having the capability to produce decompressed video, the upgrade module comprising:

providing an electronic connection to the decompression box so that the control information stream may be received from the decompression box;

demultiplexing the control information stream into graphics and text;

combining the text and graphics to produce a menu generation signal; and

transferring the menu generation signal to the decompression box, whereby the menu generation signal is processed for display.

41. A method for enhancing the functionality of a set top converter, each set top converter having a subscriber interface adapted to receive subscriber inputs and menu generation capability for operation in a cable television program delivery system, the enhanced functionality using interactive programming instructions to process interactive subscriber inputs, the method comprising the steps of:

providing an electrical connection to the set top converter, whereby the interactive subscriber inputs are transferred from the set top converter for processing and the processed interactive subscriber inputs are passed to the set top converter for display;

storing the interactive programming instructions;

accessing the stored interactive programming instructions;

executing the interactive programming instructions; and

electrically processing the interactive subscriber inputs to produce the processed interactive subscriber inputs, wherein the interactive subscriber inputs are electrically processed according to the executed interactive programming instructions.

42. A method for enhancing the functionality of a set top converter, each set top converter having a subscriber interface adapted to receive subscriber inputs and menu generation capability for operation in a cable television program delivery system, the enhanced functionality allowing reception of digital audio programs, the method comprising the steps of:

providing an electrical connection to the set top converter, wherein the subscriber inputs are passed to the set top converter for display and wherein the digital audio programs received;

processing the digital audio programs;

selecting any one of the processed digital audio programs using one or more of the menus displayed with the menu generation capability; and

enabling the subscriber inputs to produce one of the digital audio programs for listening.

43. A method for upgrading a set top converter for use in a cable television program delivery system, the set top converter having video decompression capability and an expansion card slot adapted to receive a menu generation card, the set top converter upgradeable for enhanced functionality that provides the set top converter with menu generation capability using a control information stream

received from a remote location, the method comprising the steps of:

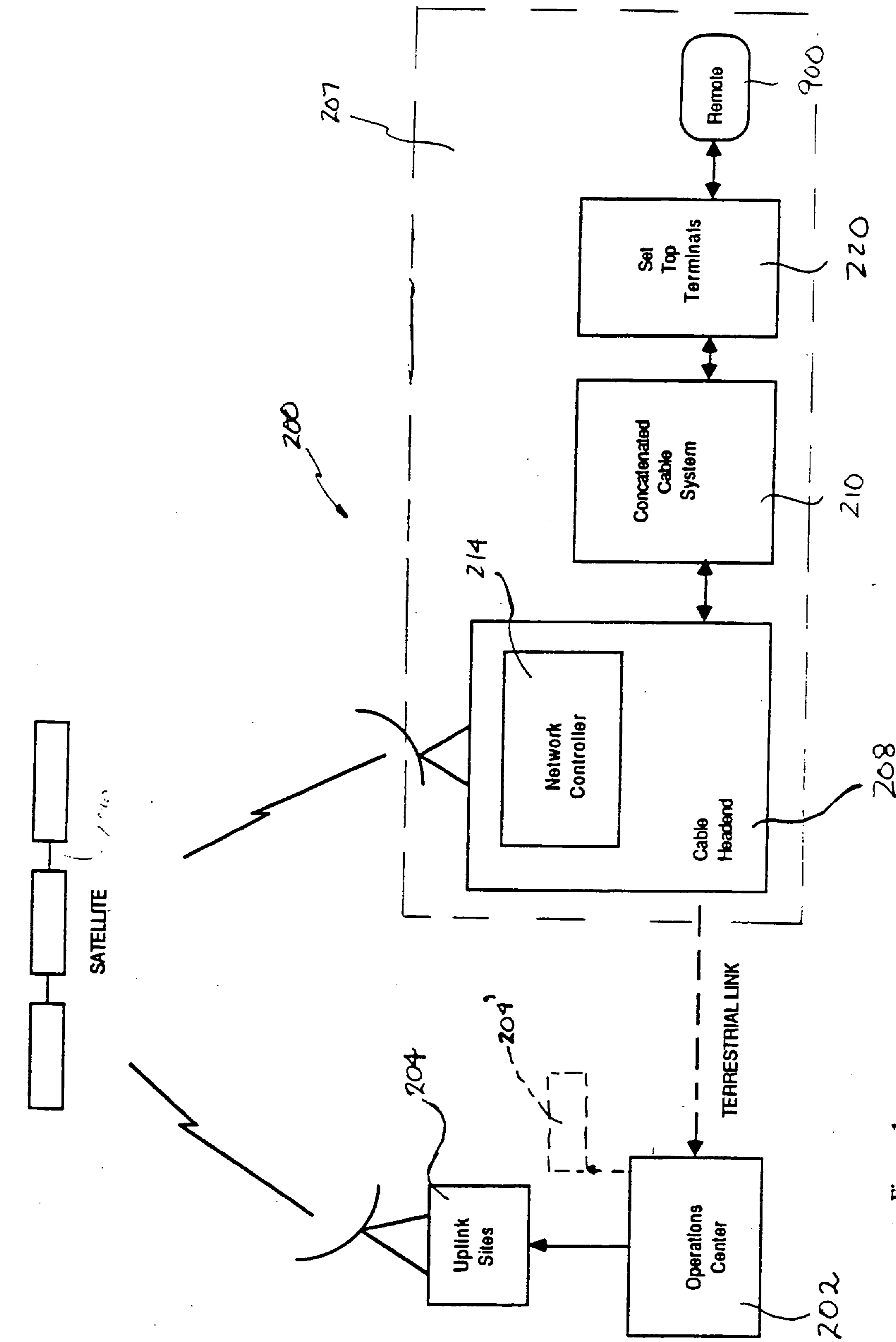
providing an electronic connection to the set top converter;

demultiplexing the control information stream into graphics and text, whereby the control information stream is received from the set top converter;

graphically decompressing the graphics to produce decompressed graphics that may be used to generate menus; and

connecting the menu generation card to the set top converter; and

using the menu generation card to combine the text and decompressed graphics to produce a menu generation signal, whereby the menu generation signal is output to the set top converter to be processed for display.



207
Remote
900
Set Top Terminals
220
Concatenated Cable System
210
200
214
Network Controller
Cable Headend
208
SATELLITE
TERRESTRIAL LINK
204'
204
Uplink Sites
Operations Center
202

Figure 1

Figure 2

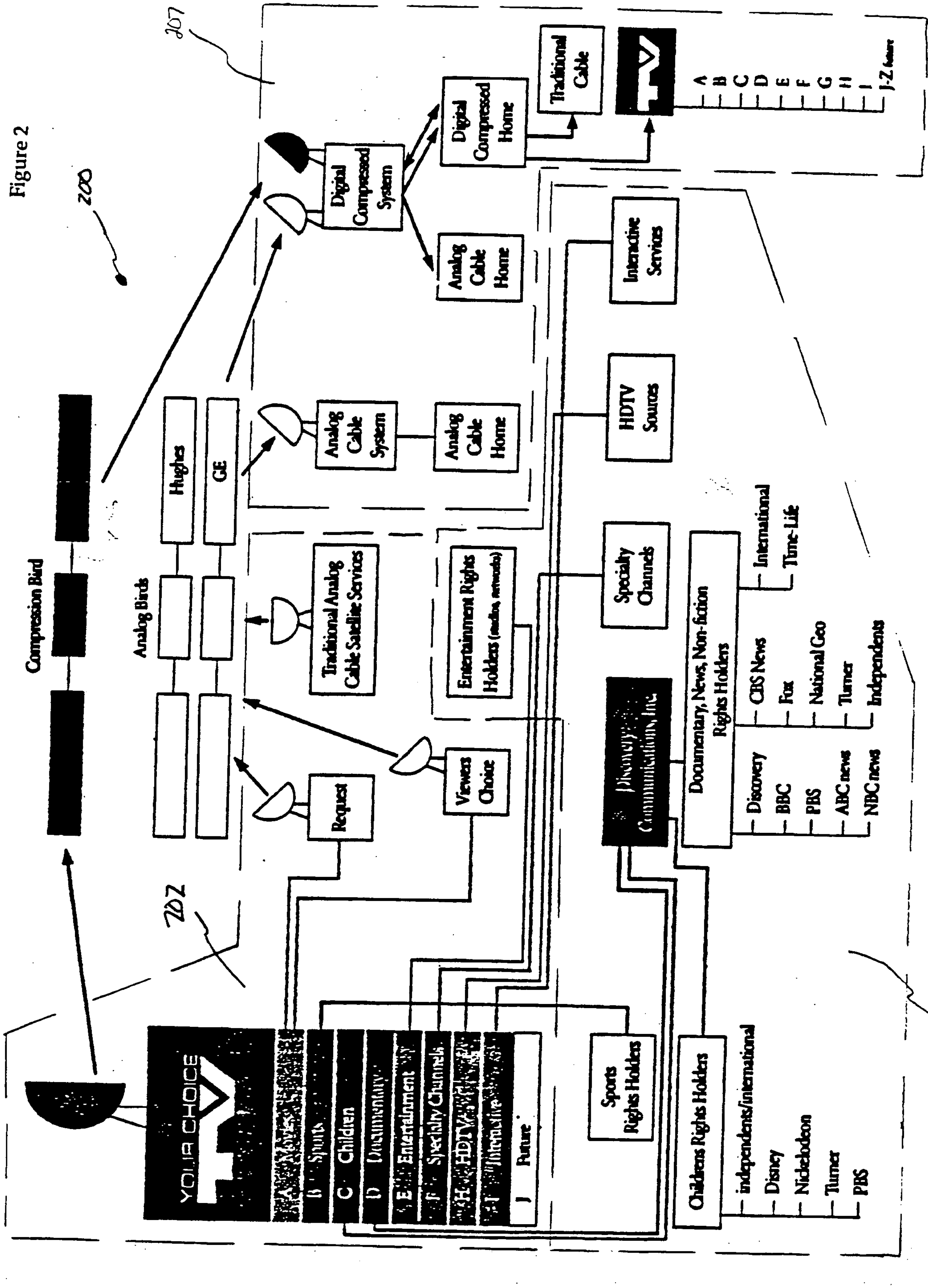
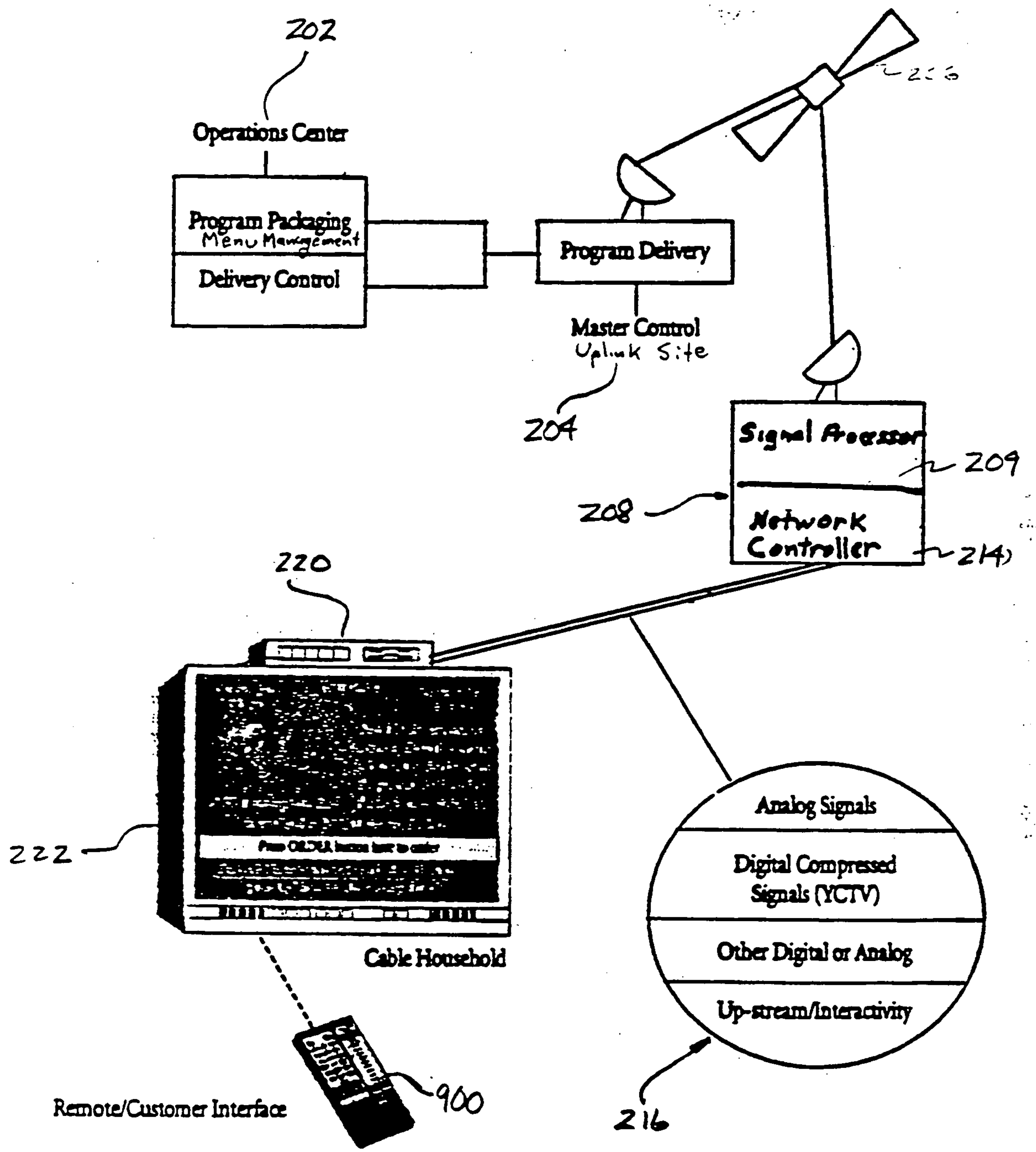

200
207
202
212
Compression Bird
Analog Birds
Hughes
GE
Traditional Analog Cable Satellite Services
Request
Viewers Choice
Analog Cable System
Analog Cable Home
Digital Compressed System
Analog Cable Home
Digital Compressed Home
Traditional Cable
A
B
C
D
E
F
G
H
I
J-Z future
Entertainment Rights Holders (studios, networks)
Interactive Services
HDTV Sources
Specialty Channels
Discovery Communications, Inc
Documentary, News, Non-fiction Rights Holders
Discovery
BBC
PBS
ABC news
NBC news
CBS News
Fox
National Geo
Turner
Independents
International
Time-Life
YOUR CHOICE TV
A Movies
B Sports
C Children
D Documentary
E Entertainment
F Specialty Channels
H HDTV
I Interactive
J Future
Sports Rights Holders
Childrens Rights Holders
independents/international
Disney
Nickelodeon
Turner
PBS

Figure 3


202
Operations Center
Program Packaging
Menu Management
Delivery Control
Program Delivery
Master Control
Uplink Site
204
206
Signal Processor
209
208
Network Controller
214
220
222
Cable Household
Analog Signals
Digital Compressed Signals (YCTV)
Other Digital or Analog
Up-stream/Interactivity
216
Remote/Customer Interface
900

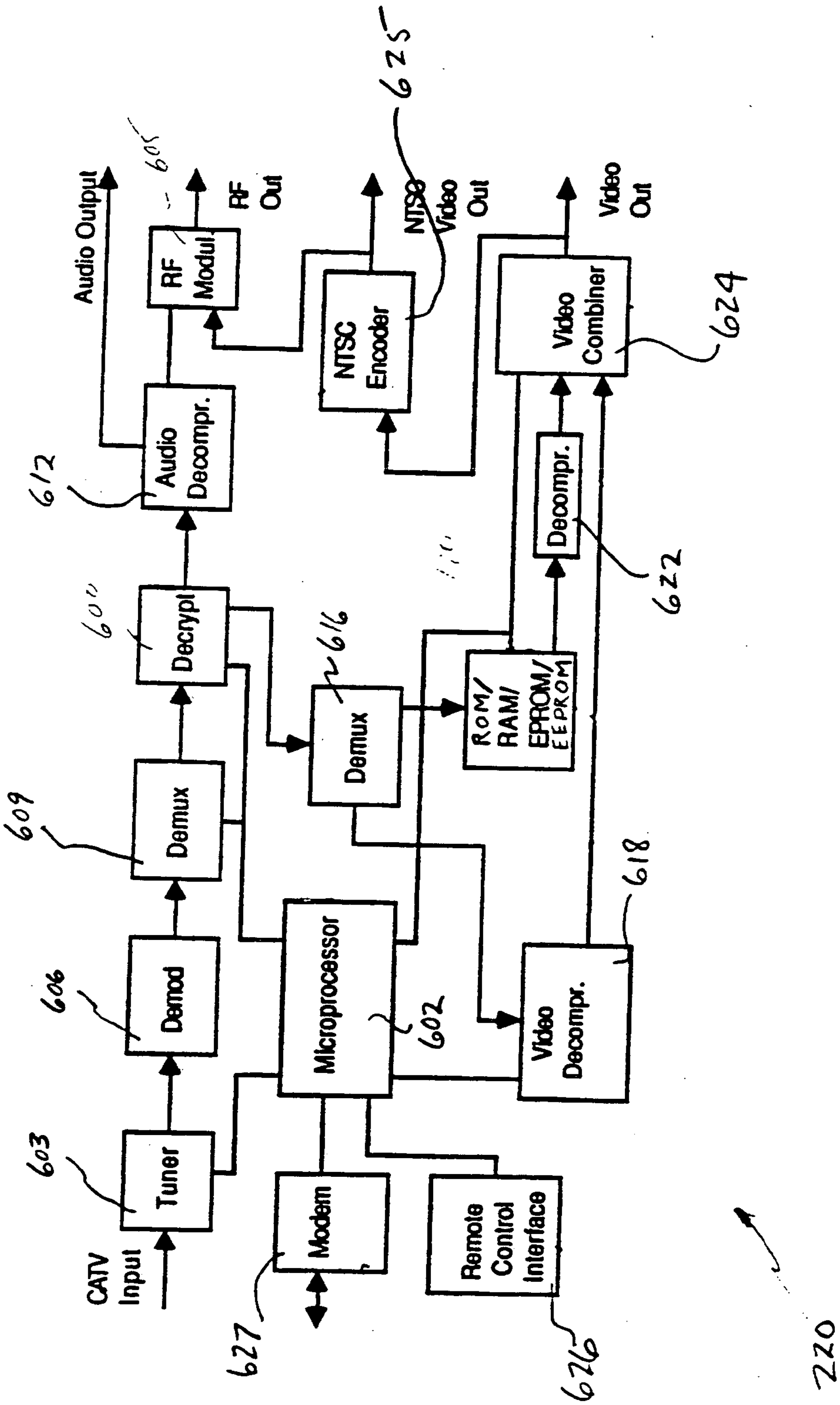

CATV Input
Tuner
603
Demod
606
Demux
609
Decrypt
600
Audio Decompr.
612
Audio Output
RF Modul.
605
RF Out
NTSC Encoder
625
NTSC Video Out
Video Combiner
624
Video Out
Demux
616
ROM/ RAM/ EPROM/ EEPROM
Decompr.
622
Microprocessor
602
Video Decompr.
618
Modem
627
Remote Control Interface
626
220

Figure 4

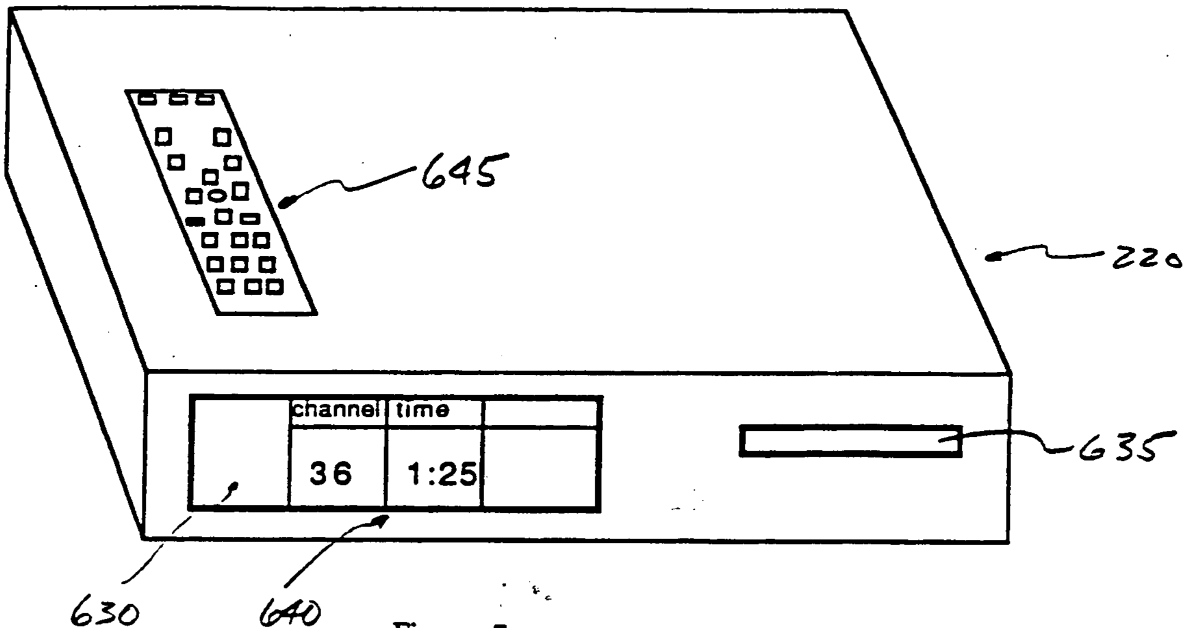


Figure 5a

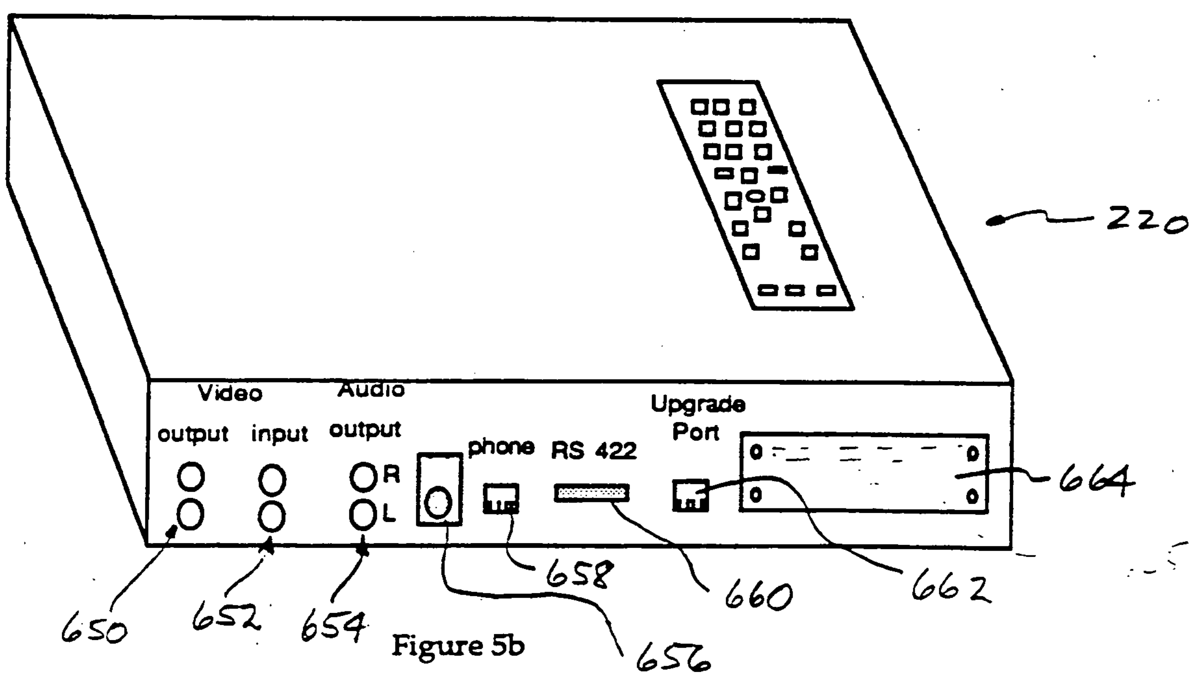


Figure 5b

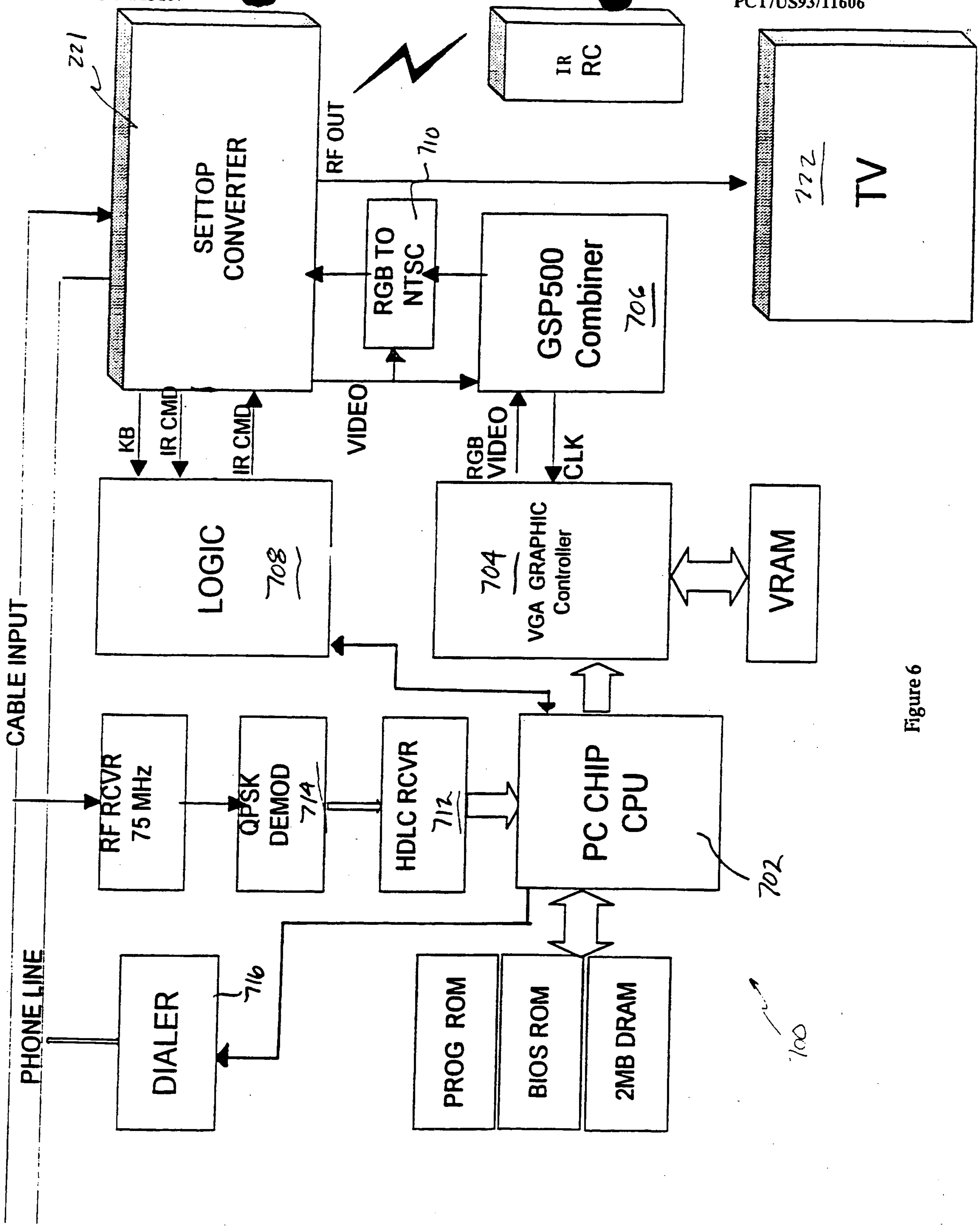

SETTOP CONVERTER
221
IR RC
RF OUT
710
TV
222
RGB TO NTSC
GSP500 Combiner
706
KB
IR CMD
IR CMD
VIDEO
RGB VIDEO
CLK
LOGIC
708
704
VGA GRAPHIC Controller
VRAM
CABLE INPUT
PHONE LINE
RF RCVR 75 MHz
QPSK DEMOD
714
HDLC RCVR
712
PC CHIP CPU
702
DIALER
716
PROG ROM
BIOS ROM
2MB DRAM
100

Figure 6

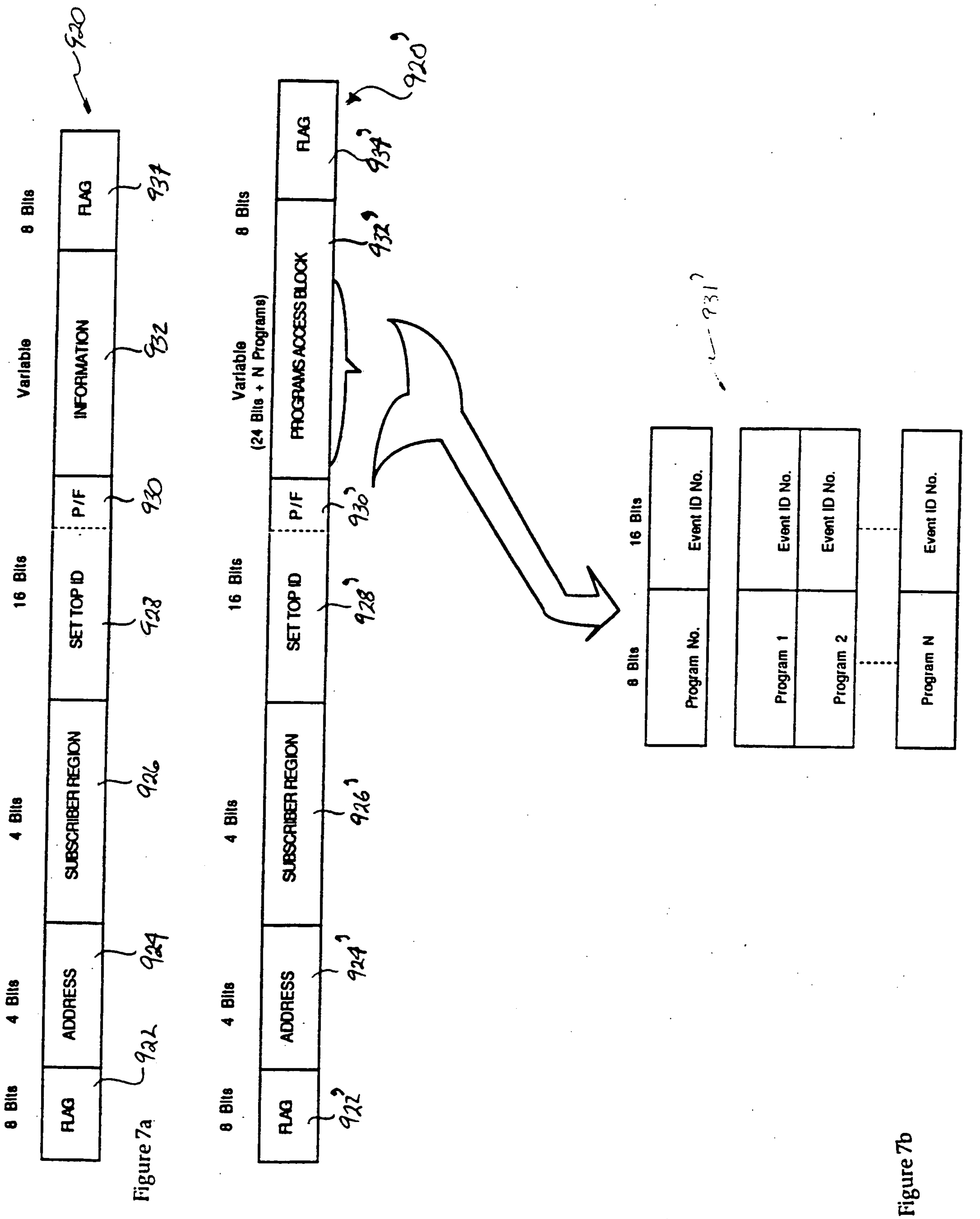


Figure 7a

Figure 7b

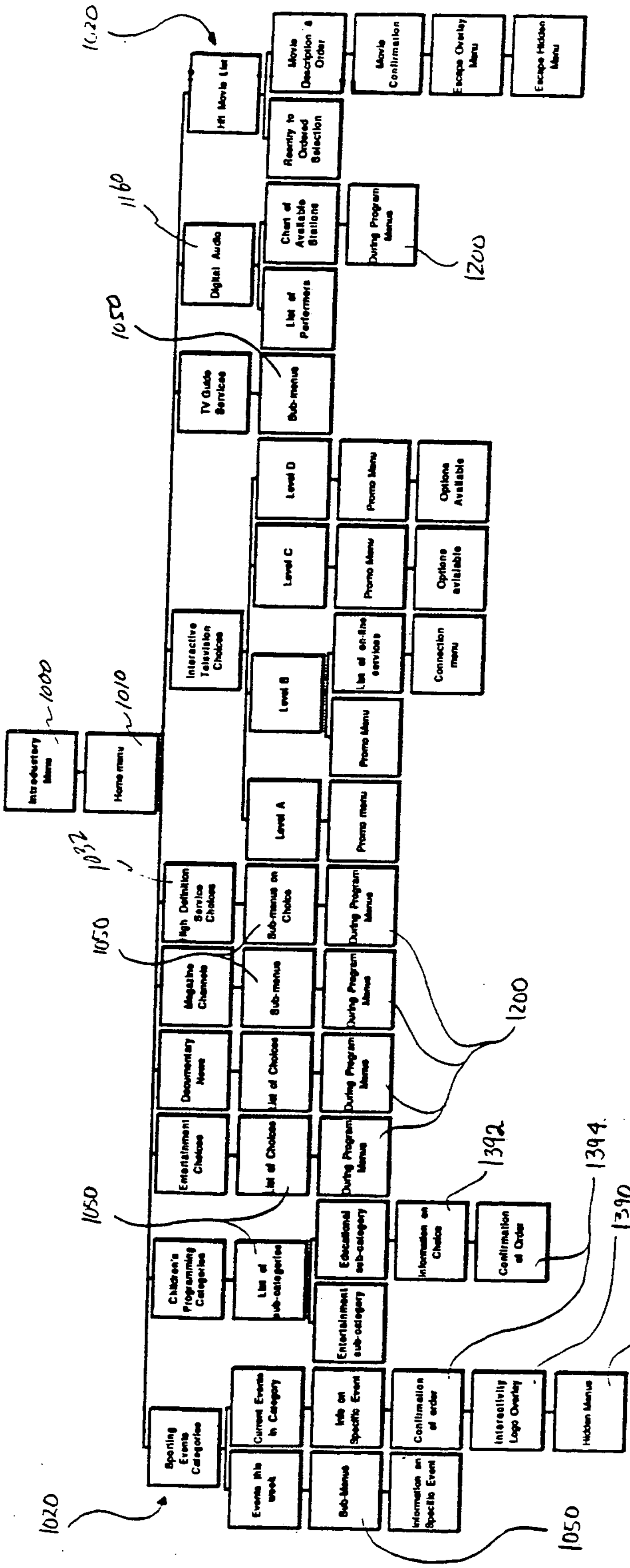

Introductory Menu
Home menu
Interactive Television Choices
TV Guide Services
Digital Audio
Movie Description & Order
Movie Confirmation
Escape Overlay Menu
Escape Hidden Menu
Reentry to Ordered Selection
Chart of Available Stations
During Program Menu
List of Performers
Sub-menu
Level D
Promo Menu
Options Available
Level C
Promo Menu
Options available
List of on-line services
Connection menu
Level B
Promo Menu
Level A
Promo menu
High Definition Service Choices
Sub-menu on Choice
During Program Menu
Magazine Channels
Sub-menu
During Program Menu
Documentary News
List of Choices
During Program Menu
Entertainment Choices
List of Choices
During Program Menu
Children's Programming Categories
List of sub-categories
Educational sub-category
Entertainment sub-category
Information on Choice
Confirmation of Order
Sporting Events Categories
Current Events in Category
Events this week
Info on Specific Event
Sub-Menu
Confirmation of order
Information on Specific Event
Interactivity Logo Overlay
Hidden Menu
1000
1010
1020
1032
1050
1160
1200
1380
1390
1392
1394

Figure 8

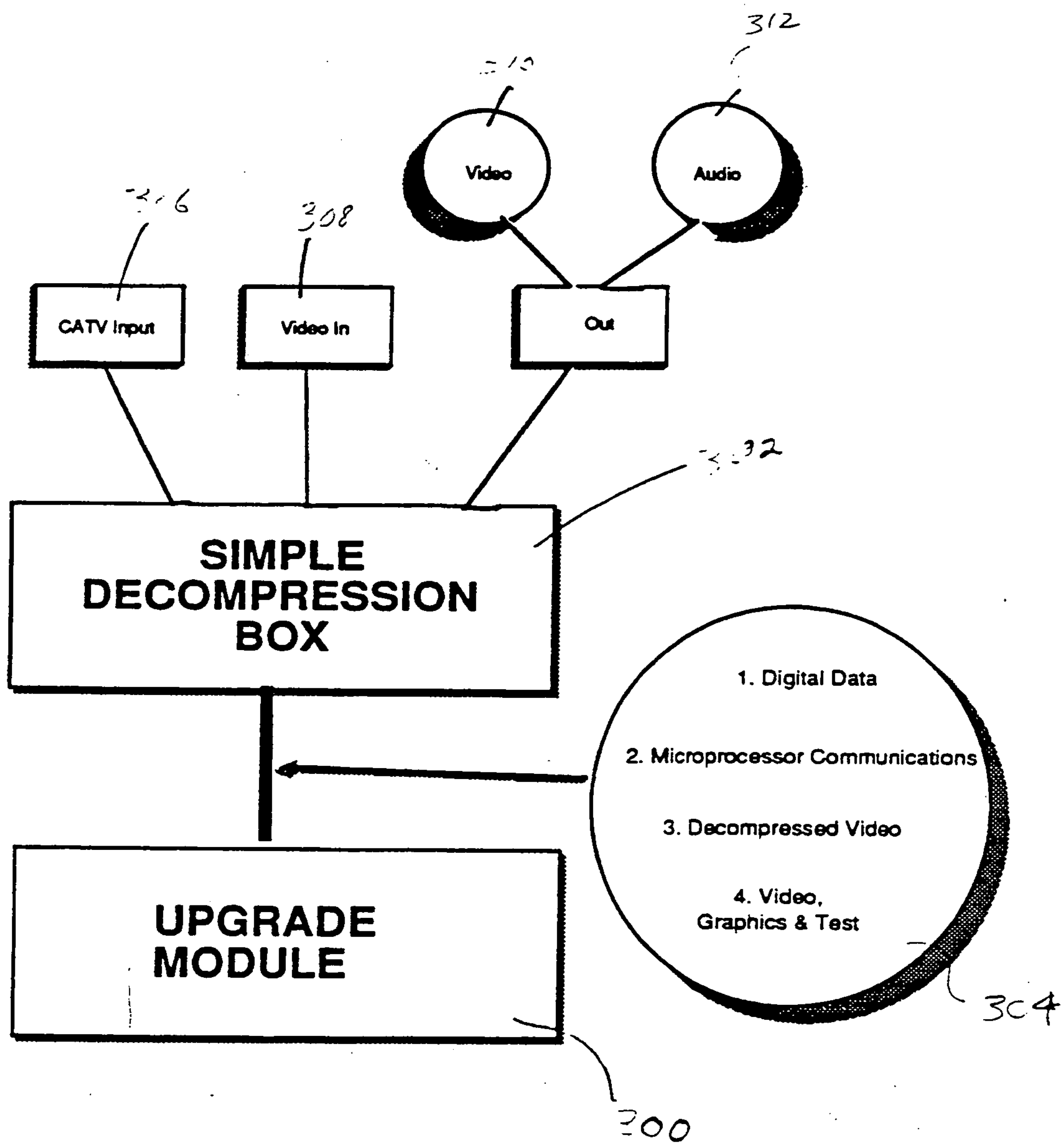

312
Video
Audio
306
308
CATV Input
Video In
Out
302
SIMPLE DECOMPRESSION BOX
1. Digital Data
2. Microprocessor Communications
3. Decompressed Video
4. Video, Graphics & Test
UPGRADE MODULE
304
300

FIG. 9a

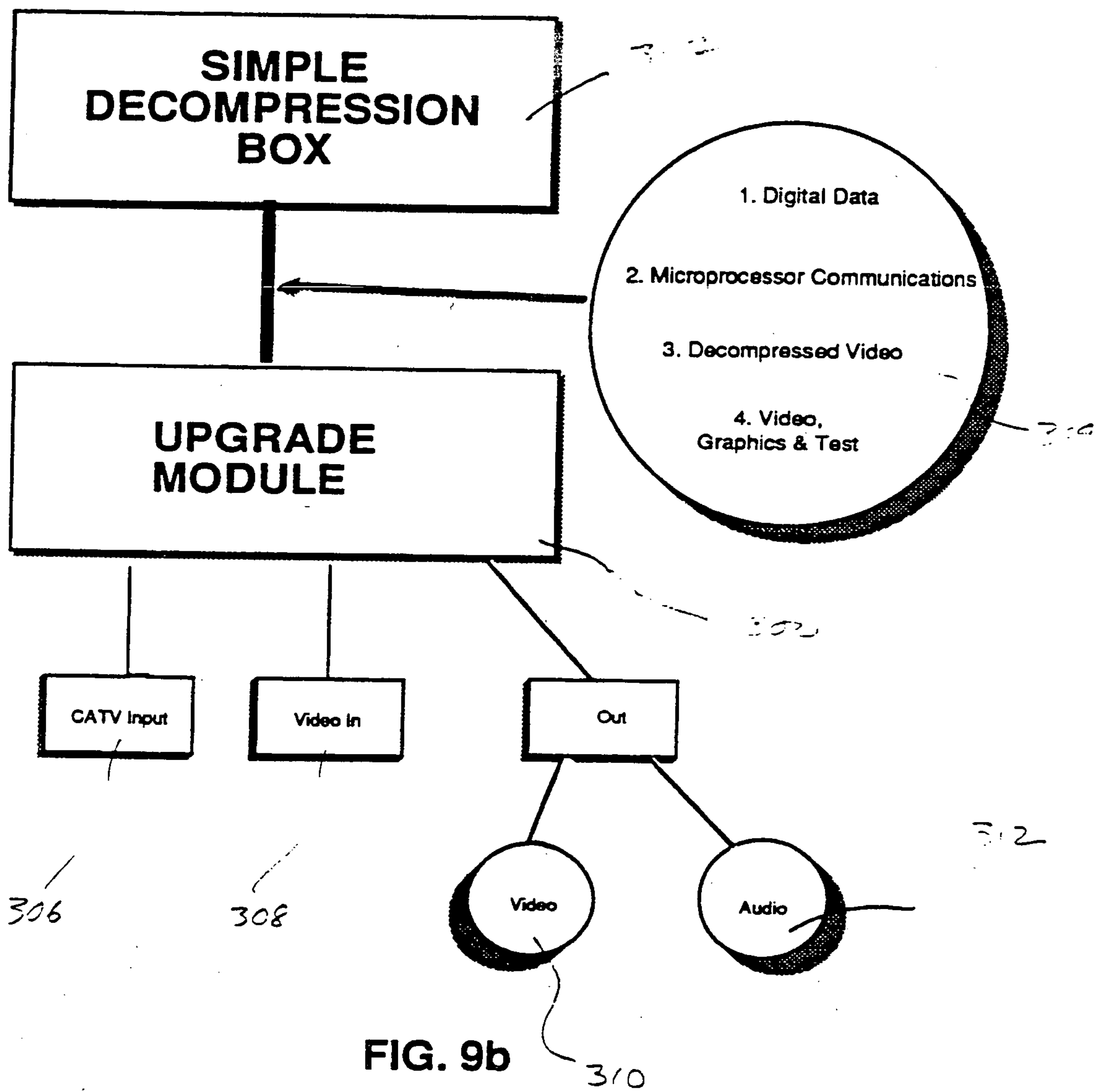

SIMPLE
DECOMPRESSION
BOX
1. Digital Data
2. Microprocessor Communications
3. Decompressed Video
4. Video,
Graphics & Test
UPGRADE
MODULE
CATV Input
Video In
Out
Video
Audio
306
308
310

FIG. 9b

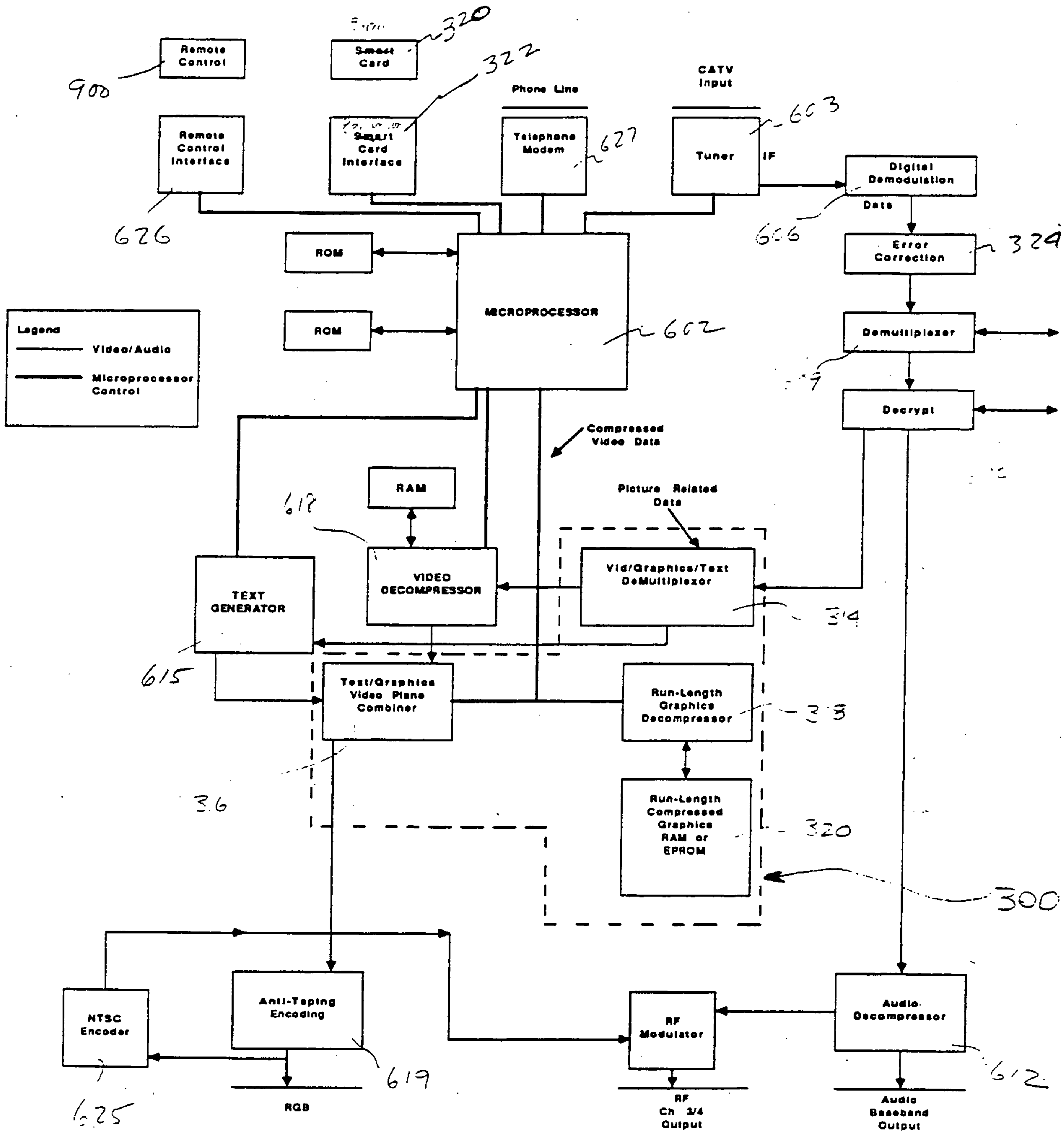
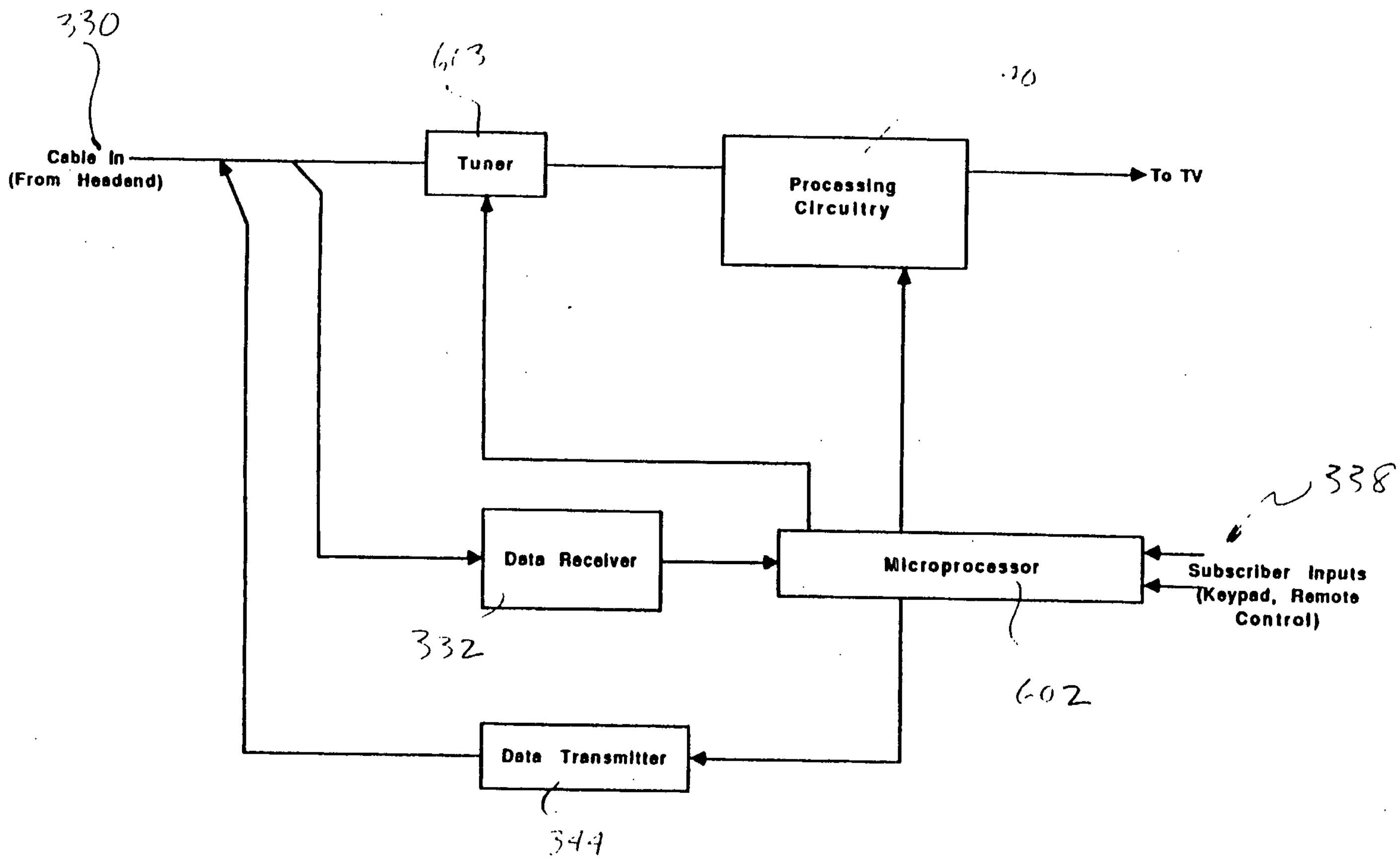

Remote Control
900
Smart Card
320
322
Phone Line
CATV Input
603
Remote Control Interface
Smart Card Interface
Telephone Modem
627
Tuner
IF
Digital Demodulation
Data
606
626
ROM
ROM
MICROPROCESSOR
602
Error Correction
324
Demultiplexer
Decrypt
Legend
Video/Audio
Microprocessor Control
Compressed Video Data
RAM
618
Picture Related Data
TEXT GENERATOR
VIDEO DECOMPRESSOR
Vid/Graphics/Text DeMultiplexor
314
615
Text/Graphics Video Plane Combiner
Run-Length Graphics Decompressor
318
316
Run-Length Compressed Graphics RAM or EPROM
320
300
NTSC Encoder
Anti-Taping Encoding
619
RF Modulator
Audio Decompressor
612
625
RGB
RF Ch 3/4 Output
Audio Baseband Output

FIG. 10



Set Top Terminal Upstream Data Transmission Hardware

FIG. 11

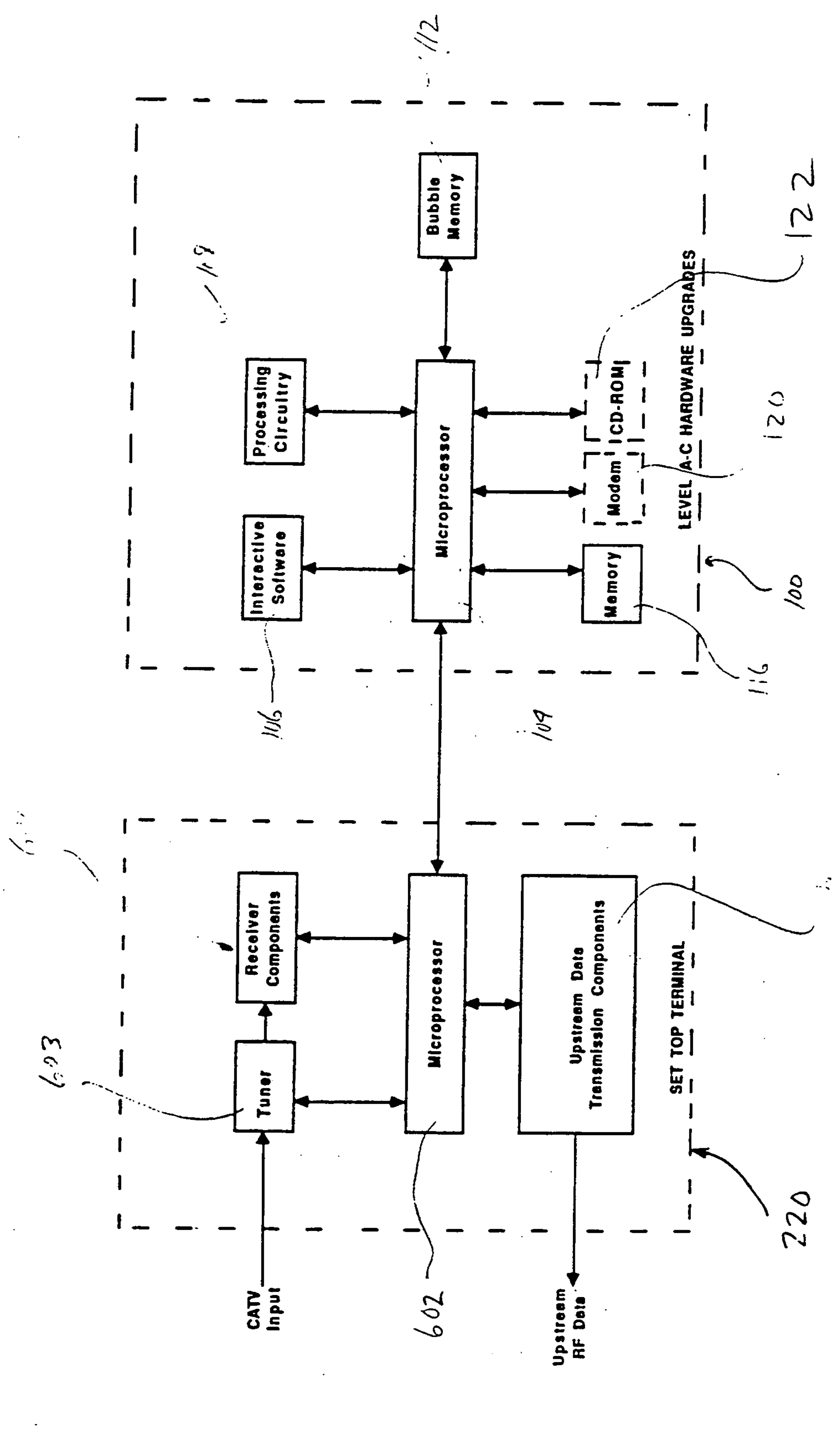

112
Bubble Memory
Processing Circuitry
Interactive Software
Microprocessor
Modem
CD-ROM
Memory
LEVEL A-C HARDWARE UPGRADES
122
120
100
116
106
109
Receiver Components
Tuner
Microprocessor
Upstream Data Transmission Components
SET TOP TERMINAL
220
CATV Input
602
Upstream RF Data

FIG. 12a

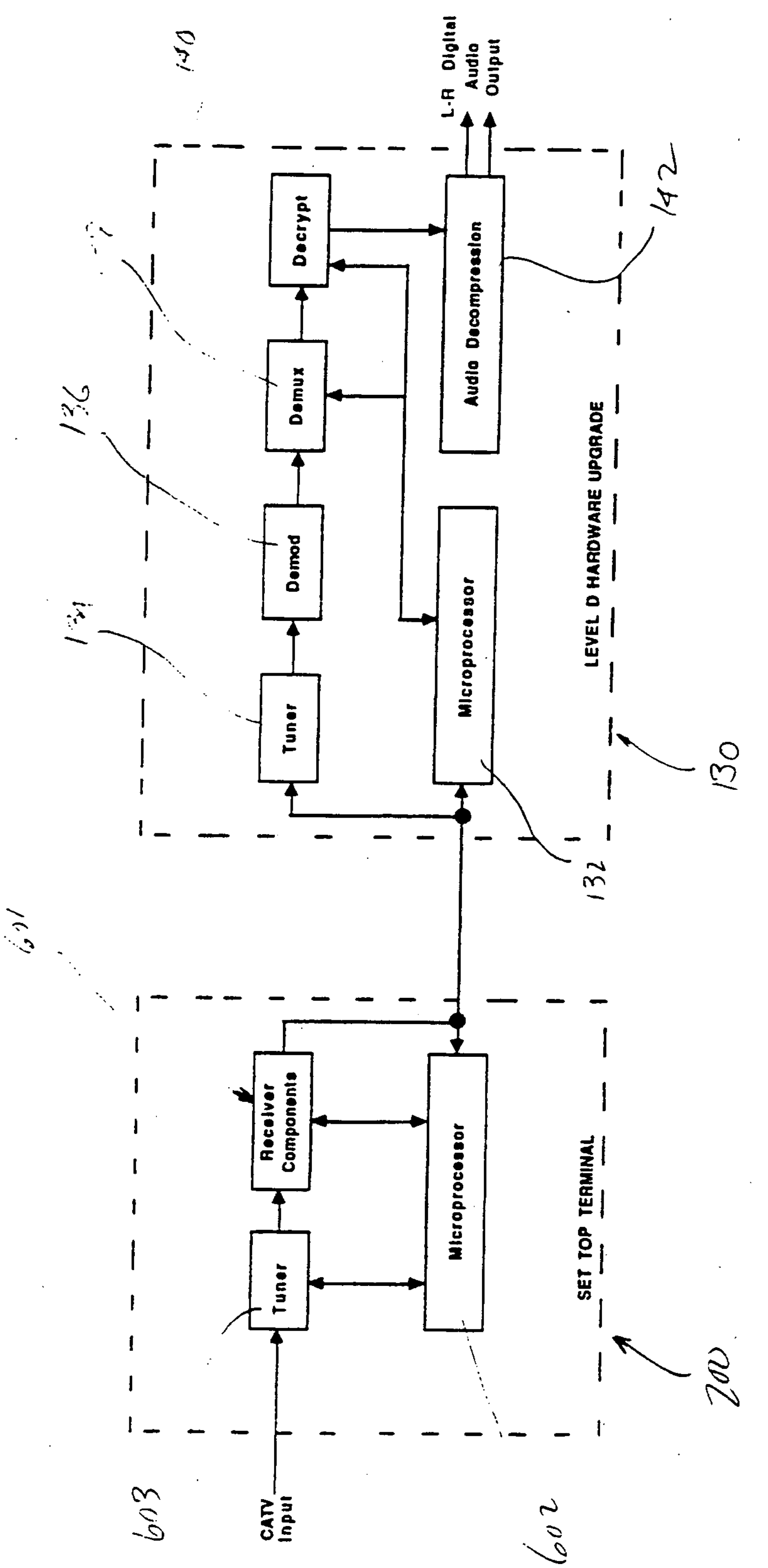

L-R Digital Audio Output
Decrypt
Demux
Demod
Tuner
Audio Decompression
Microprocessor
LEVEL D HARDWARE UPGRADE
Receiver Components
Microprocessor
Tuner
SET TOP TERMINAL
CATV Input
140
142
136
132
130
200
603
602

FIG. 12b

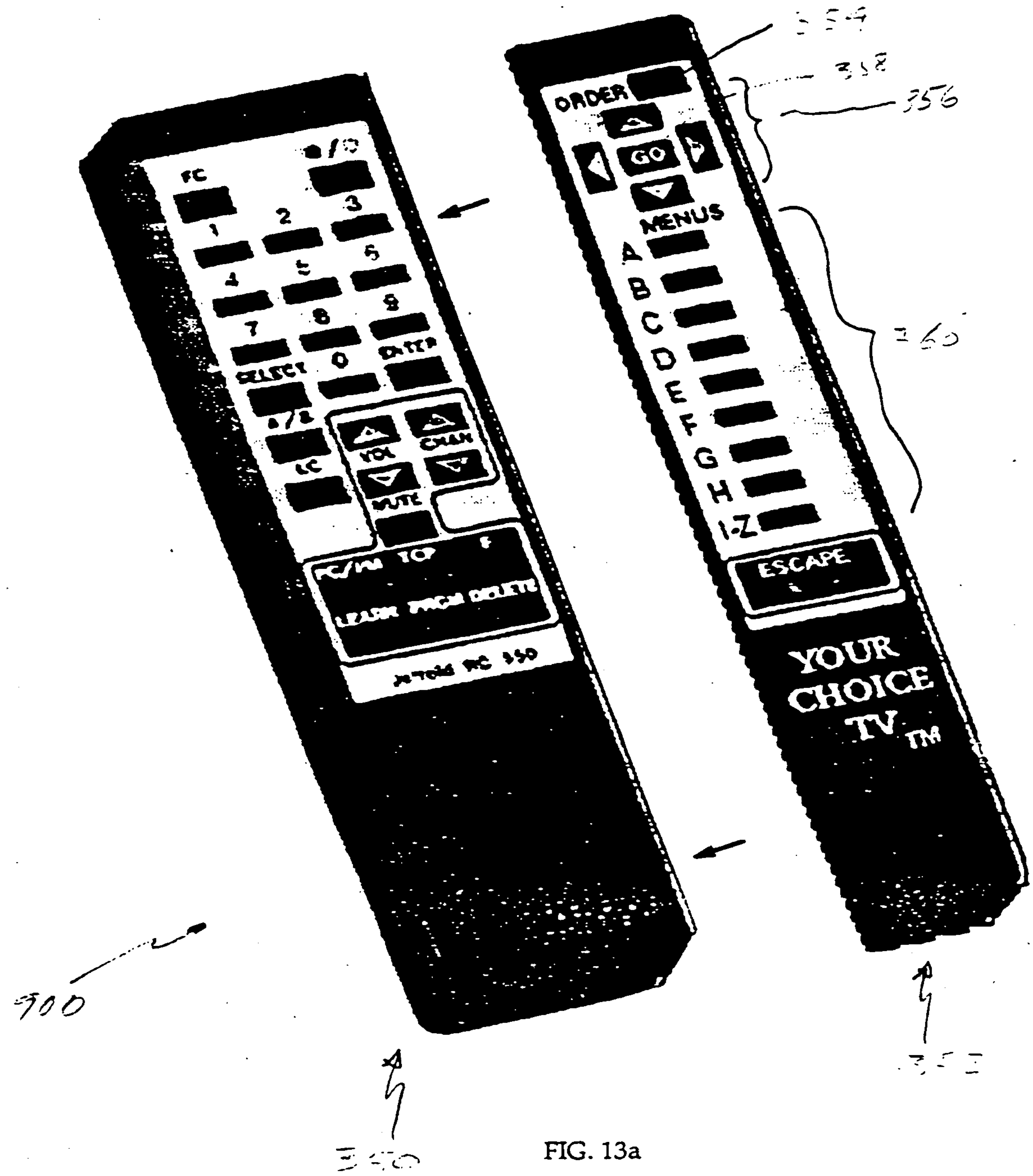


FIG. 13a

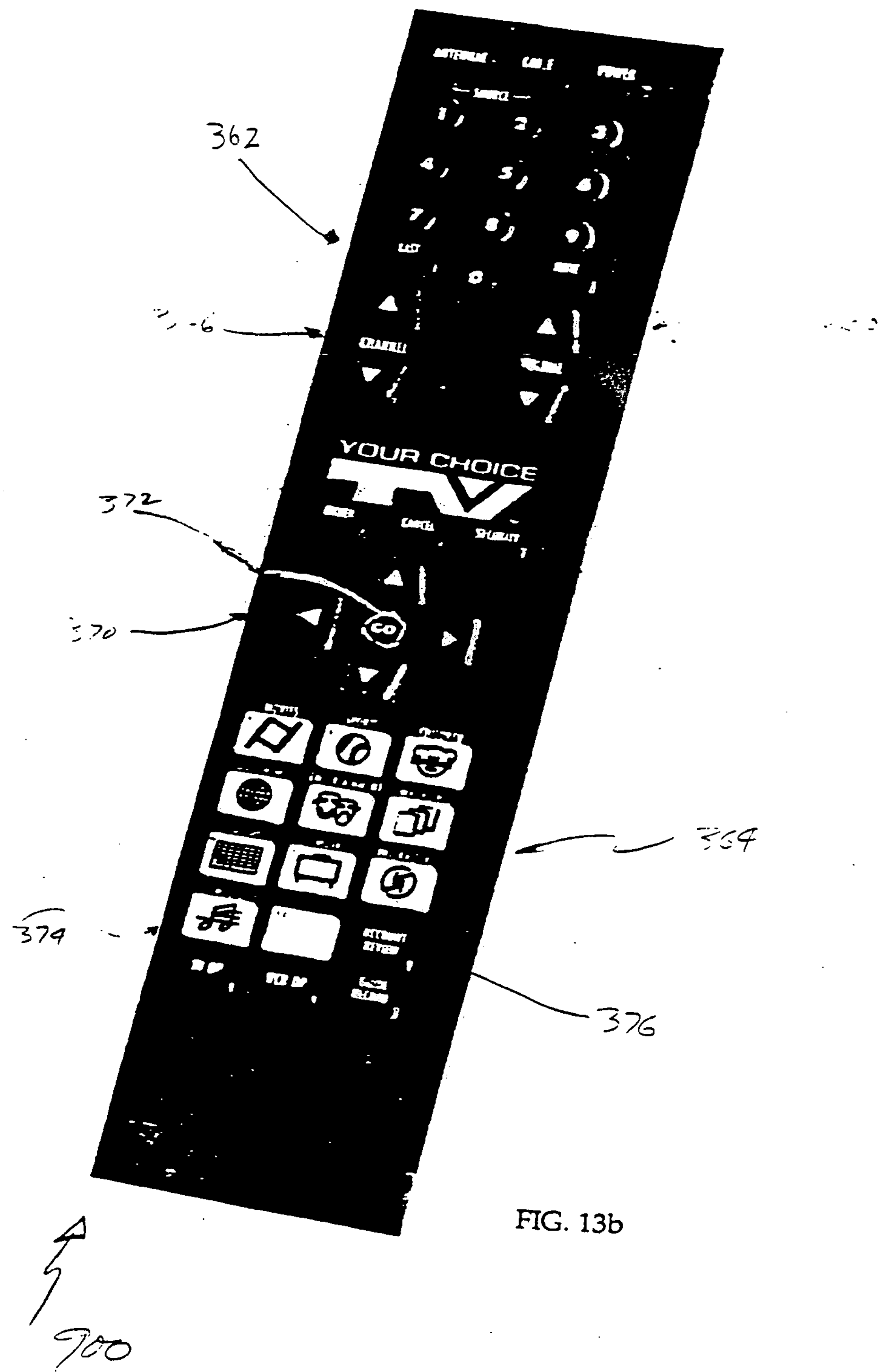


FIG. 13b

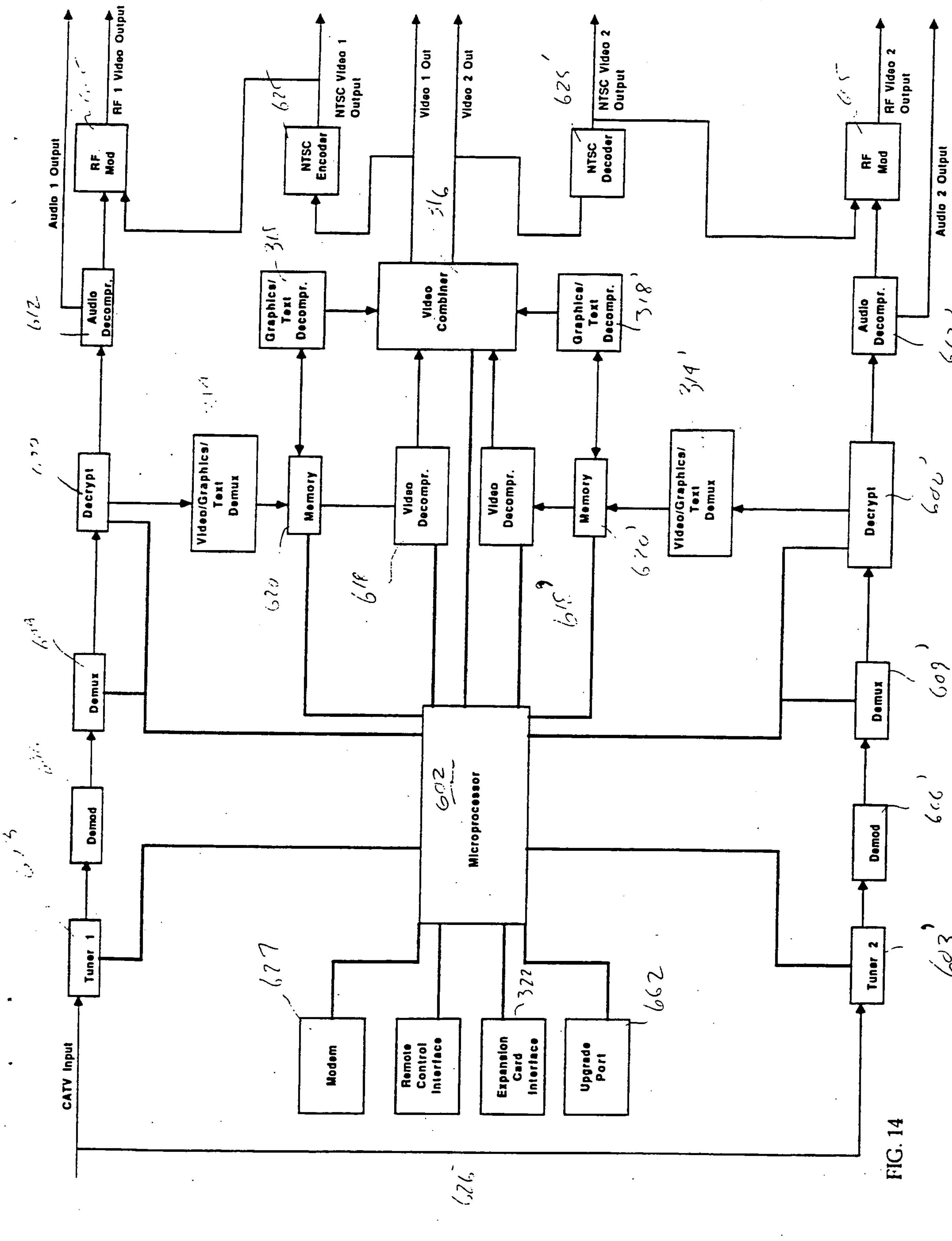

CATV Input
Tuner 1
Demod
Demux
Decrypt
Audio Decompr.
RF Mod
Audio 1 Output
RF 1 Video Output
Video/Graphics/Text Demux
Memory
Graphics/Text Decompr.
Video Decompr.
Video Combiner
NTSC Encoder
NTSC Video 1 Output
Video 1 Out
Video 2 Out
NTSC Decoder
NTSC Video 2 Output
RF Mod
RF Video 2 Output
Audio 2 Output
Audio Decompr.
Graphics/Text Decompr.
Video Decompr.
Memory
Video/Graphics/Text Demux
Decrypt
Demux
Demod
Tuner 2
Microprocessor
Modem
Remote Control Interface
Expansion Card Interface
Upgrade Port
602
622
322
662
626
603'
606'
609'
600'
612'
620'
615'
618
620
612
315
316
318'
314'
625'
625

FIG. 14

FIG. 15

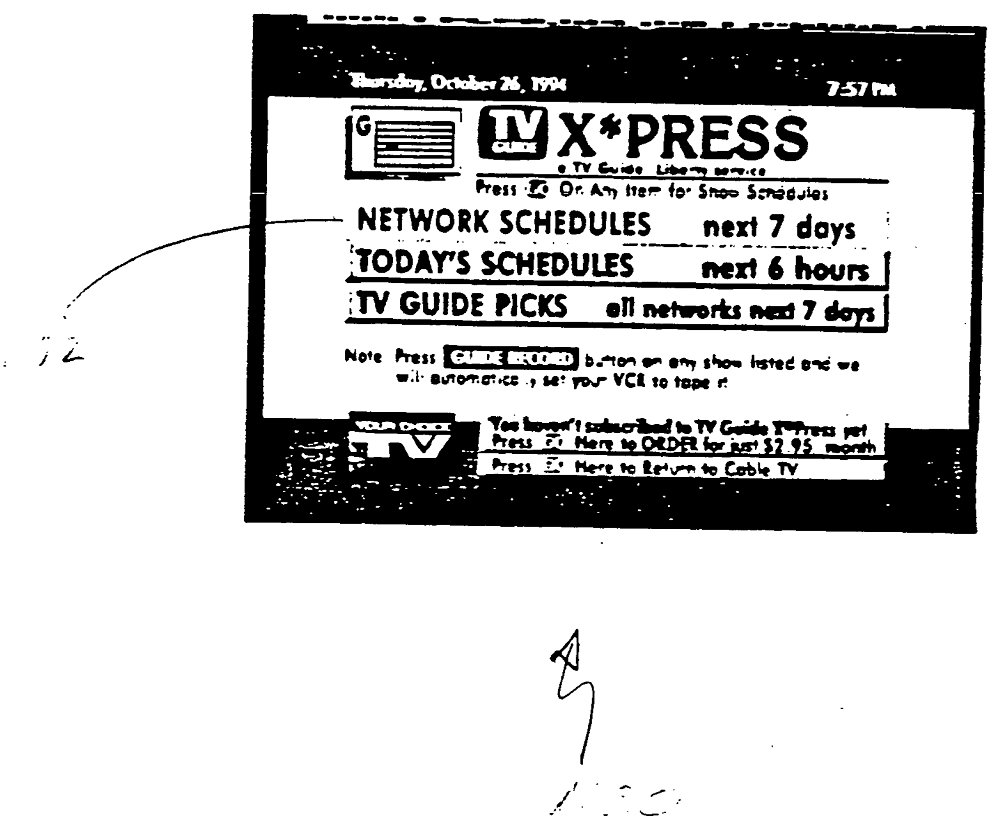
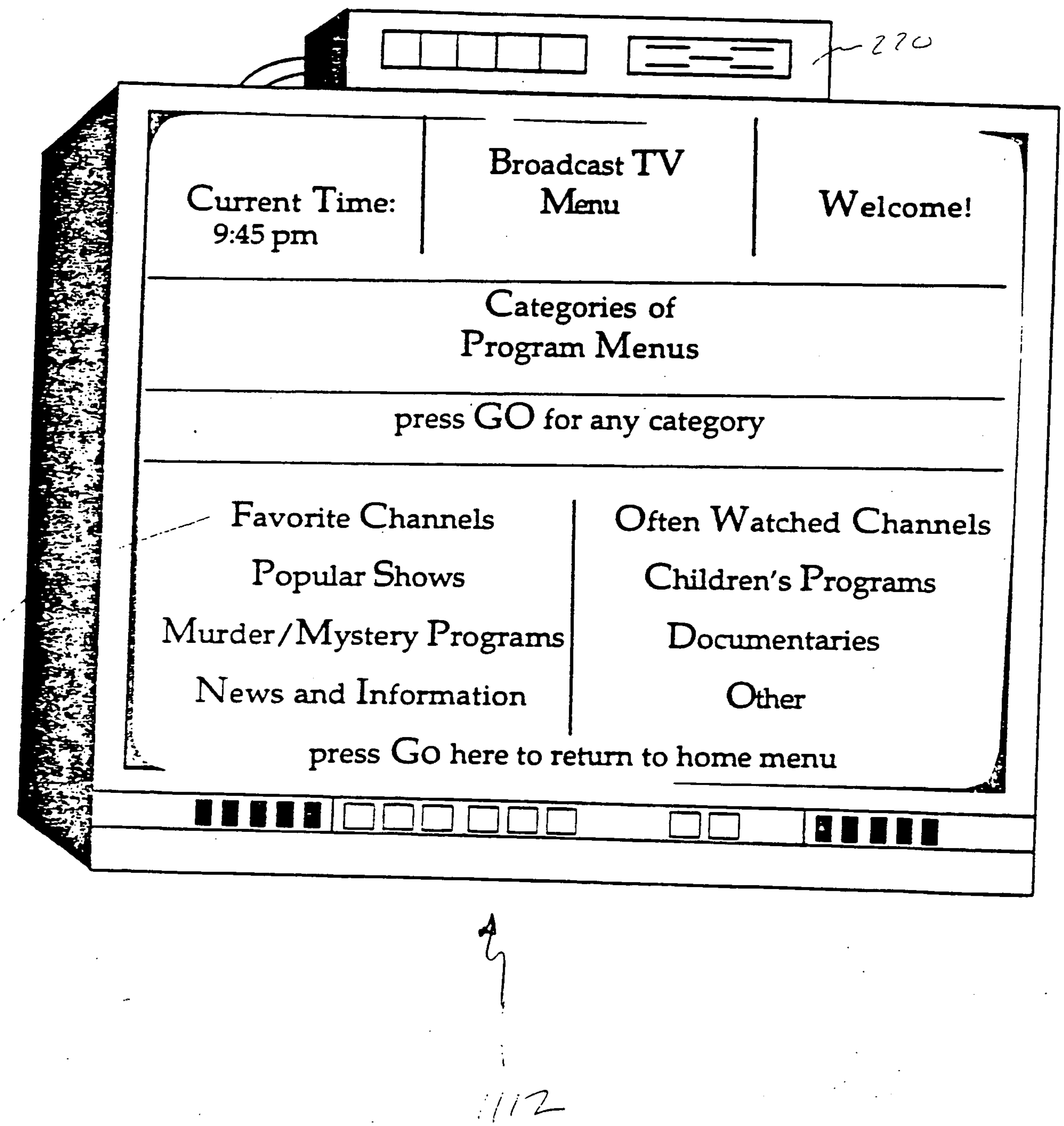

Thursday, October 26, 1994
7:57 PM
X*PRESS
a TV Guide Liberty service
Press On Any Item for Show Schedules
NETWORK SCHEDULES next 7 days
TODAY'S SCHEDULES next 6 hours
TV GUIDE PICKS all networks next 7 days
Note Press GUIDE RECORD button on any show listed and we will automatically set your VCR to tape it
You haven't subscribed to TV Guide X*Press yet
Press Here to ORDER for just $2.95 month
Press Here to Return to Cable TV
72
100

FIG. 16a


220
Current Time:
9:45 pm
Broadcast TV
Menu
Welcome!
Categories of
Program Menus
press GO for any category
Favorite Channels
Popular Shows
Murder/Mystery Programs
News and Information
Often Watched Channels
Children's Programs
Documentaries
Other
press Go here to return to home menu
112

MOOD QUESTION MENUS

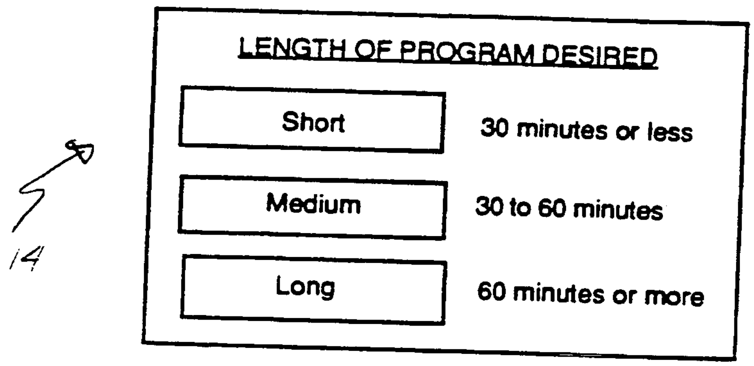


FIG. 16b

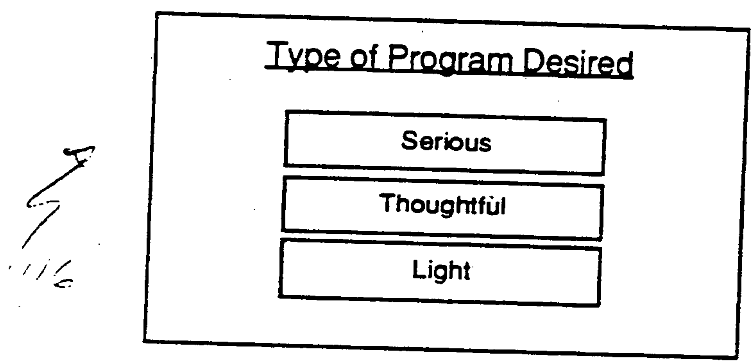


FIG. 16c

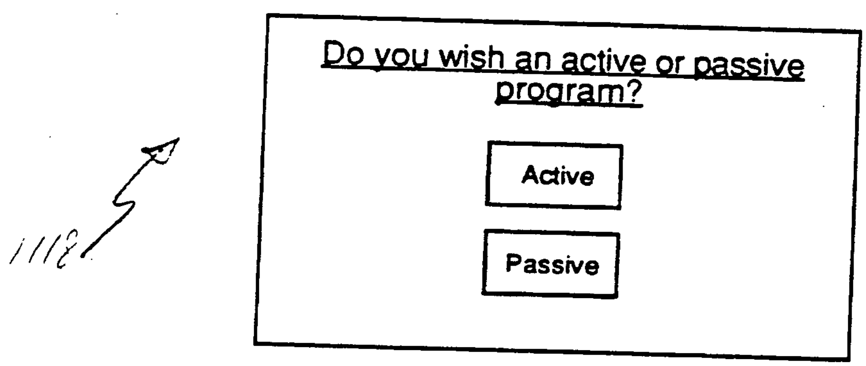


FIG. 16d

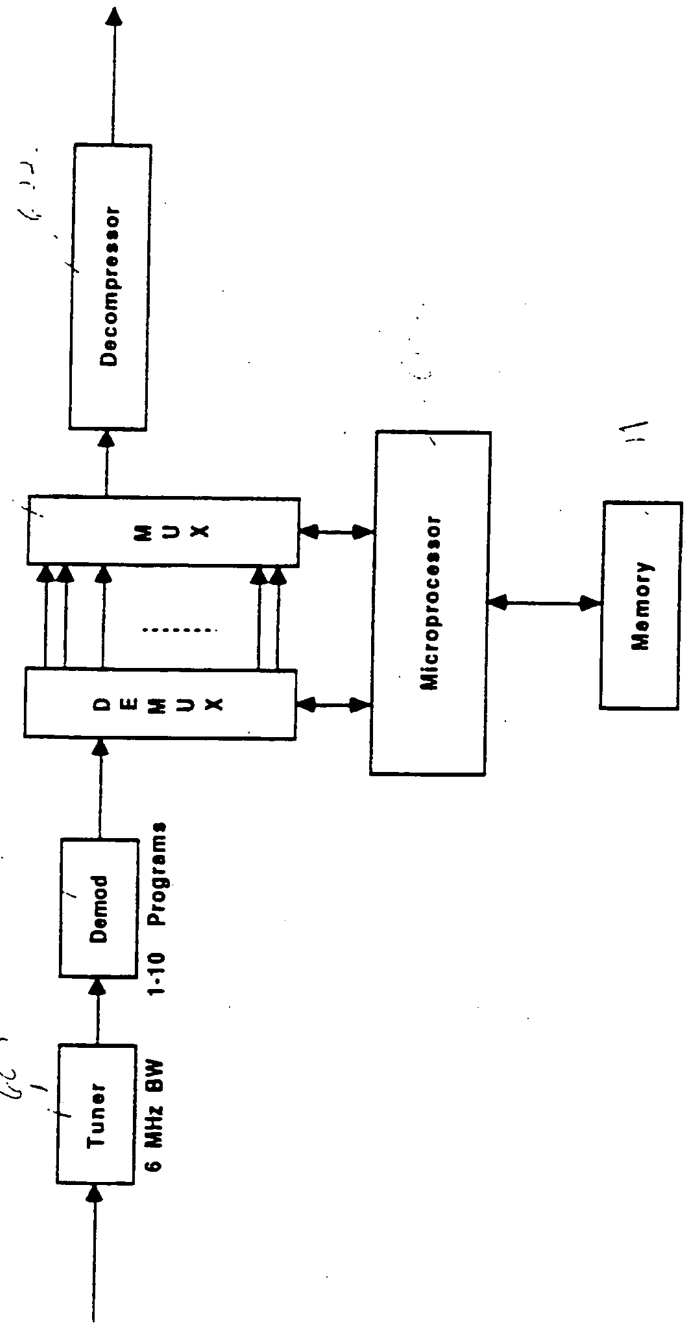


FIG. 17a

STT CHANNEL SWITCHING HARDWARE: CHANNEL SWITCHING WITHIN 6MHz BANDWIDTH

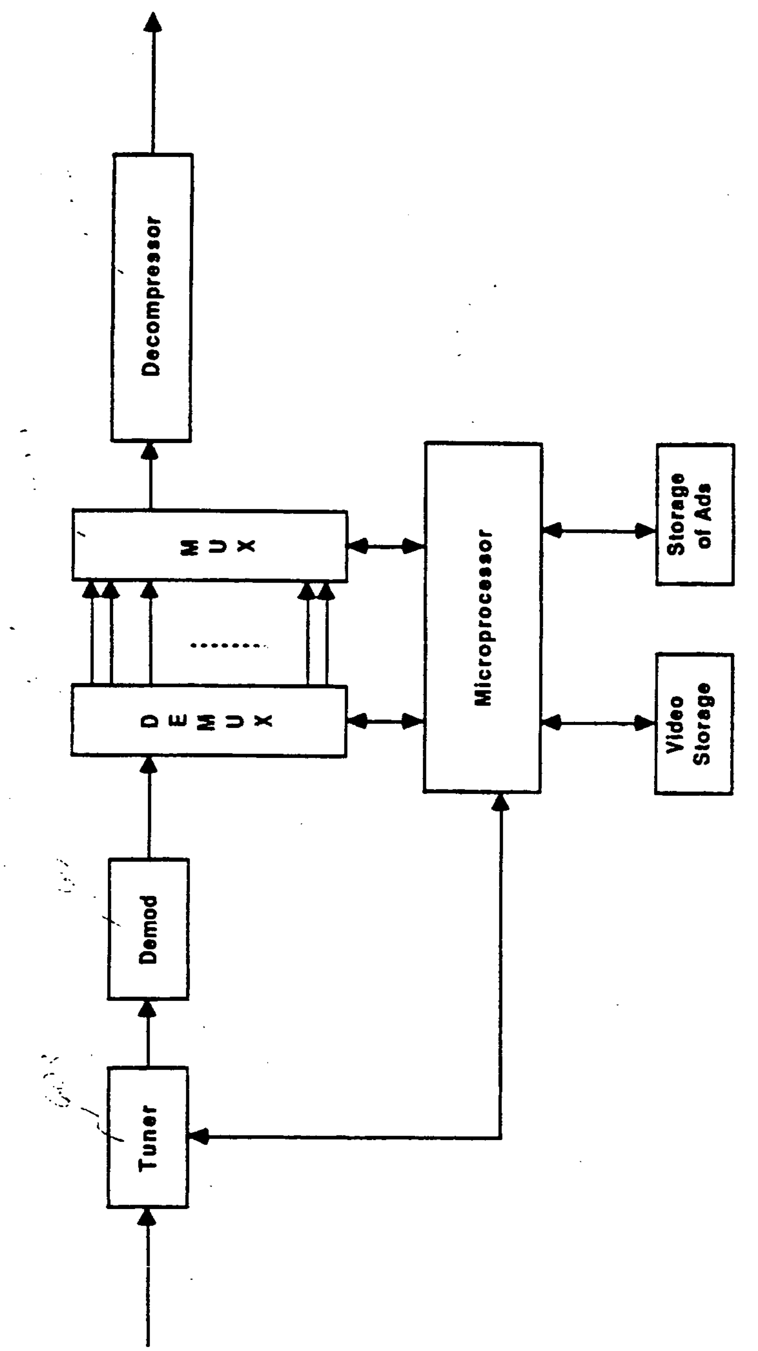
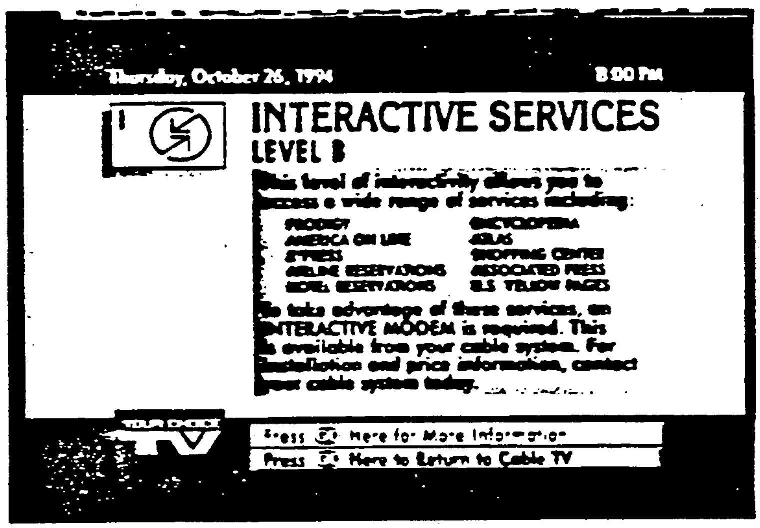


FIG. 17b

STT CHANNEL SWITCHING HARDWARE: CHANNEL SWITCHING OUTSIDE 6MHz BANDWIDTH

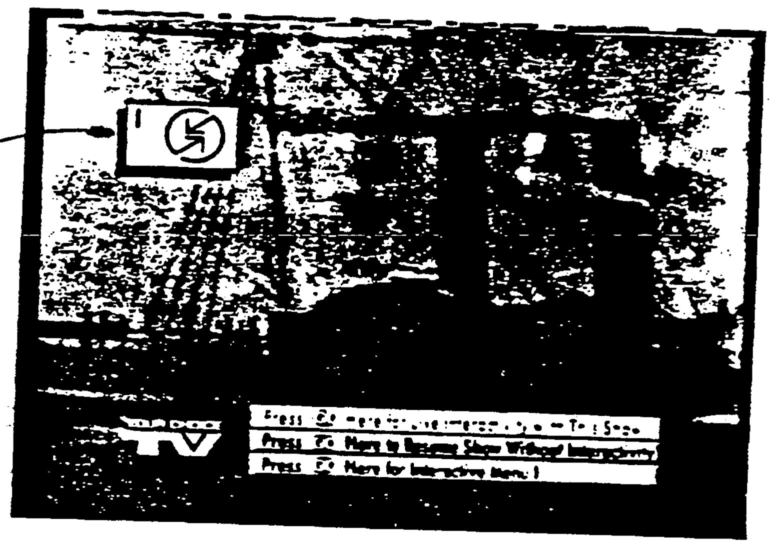
FIG. 18


Thursday, October 26, 1994
8:00 PM
INTERACTIVE SERVICES
LEVEL B
This level of interactivity allows you to access a wide range of services including:
PRODIGY
AMERICA ON LINE
AIRLINE RESERVATIONS
HOTEL RESERVATIONS
ENCYCLOPEDIA
ATLAS
SHOPPING CENTER
ASSOCIATED PRESS
U.S. YELLOW PAGES
To take advantage of these services, an INTERACTIVE MODEM is required. This is available from your cable system. For installation and price information, contact your cable system today.
TV
Press Here for More Information
Press Here to Return to Cable TV

1120

FIG. 19a

1134



1130

FIG. 19b

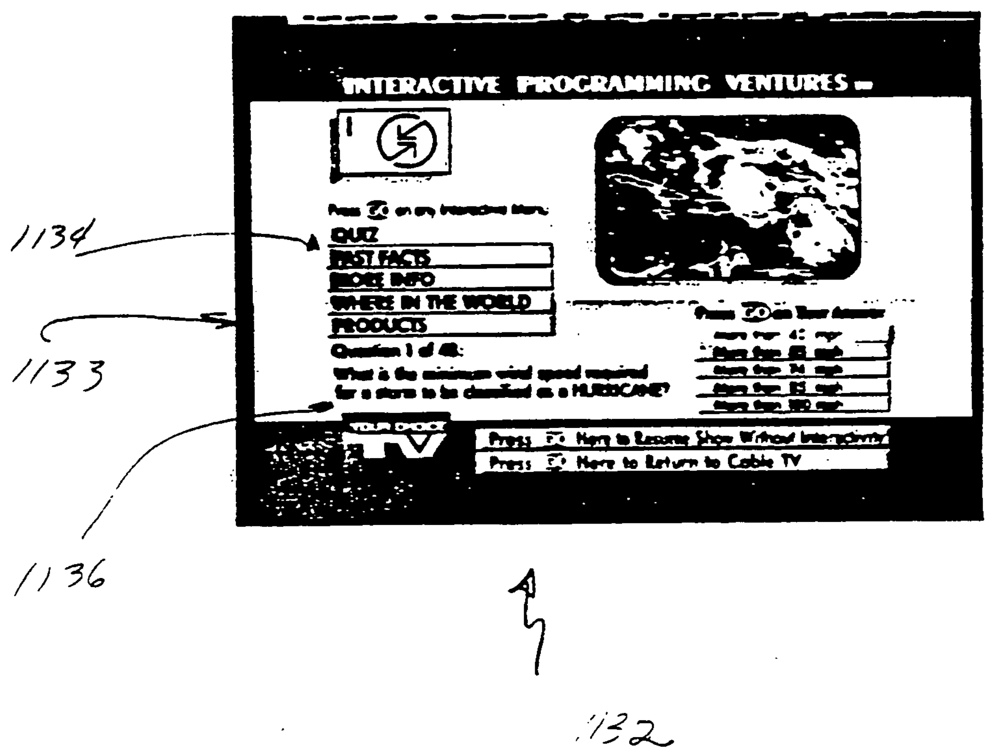
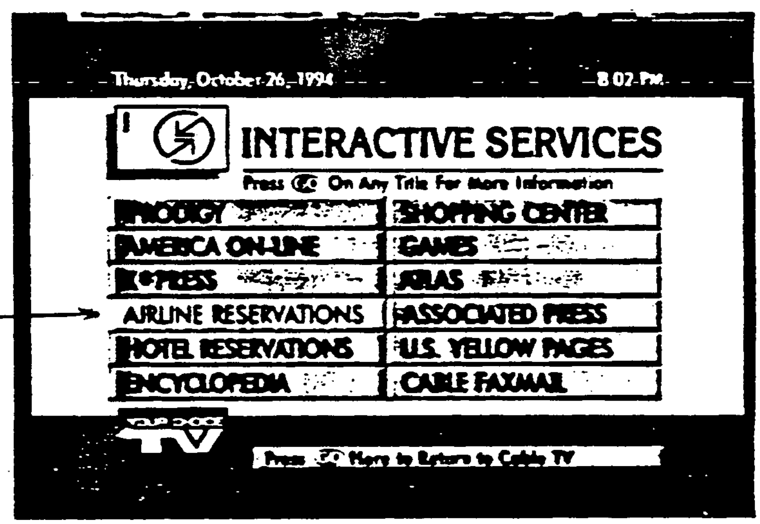

INTERACTIVE PROGRAMMING VENTURES
QUIZ
FAST FACTS
MORE INFO
WHERE IN THE WORLD
PRODUCTS
Question 1 of 48:
for a storm to be classified as a HURRICANE?
TV
Press Here to Resume Show Without Interactivity
Press Here to Return to Cable TV
1134
1133
1136
1132

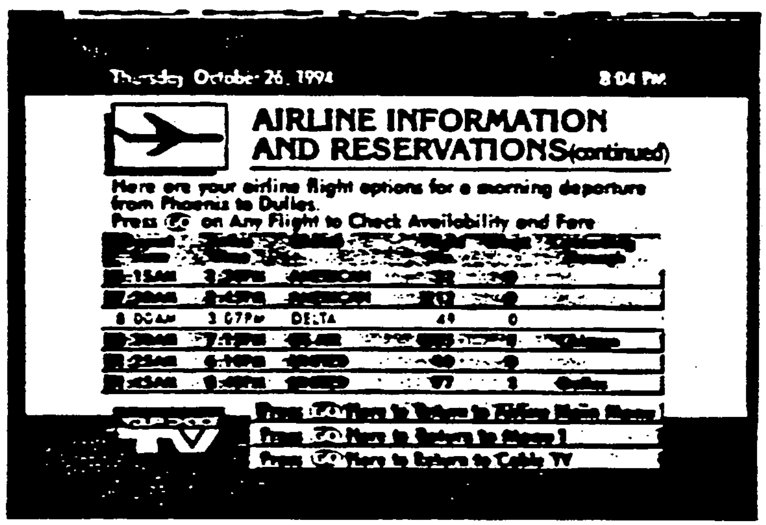
FIG. 20a

1142



1140

FIG. 20b


Thursday October 26, 1994
8:04 PM
AIRLINE INFORMATION
AND RESERVATIONS(continued)
Here are your airline flight options for a morning departure from Phoenix to Dulles.
Press on Any Flight to Check Availability and Fare
8:00AM 3:07PM DELTA 49 0
Press Here to Return to Airline Main Menu
Press Here to Return to Menu 1
Press Here to Return to Cable TV

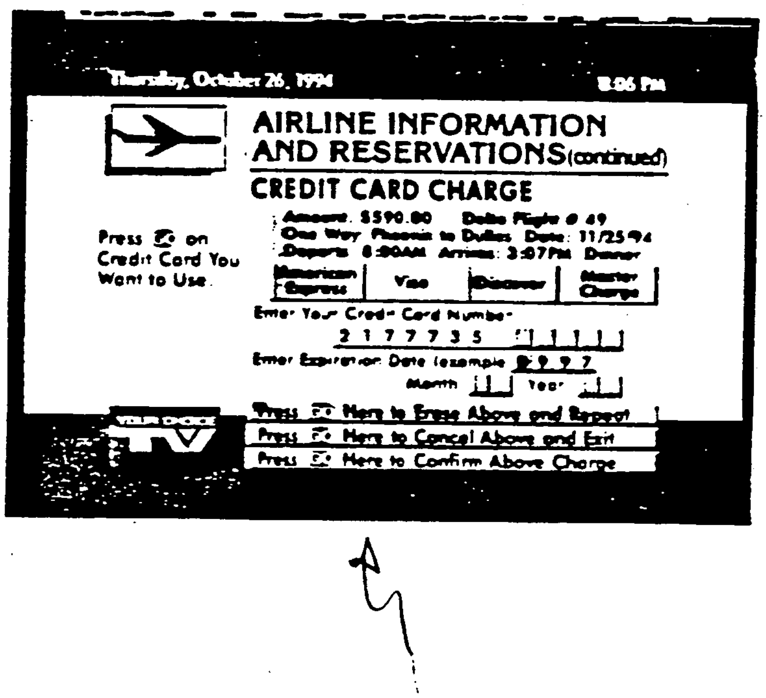
1144

FIG. 20c

1152

1150

FIG. 20d


Thursday, October 26, 1994
8:06 PM
AIRLINE INFORMATION AND RESERVATIONS(continued)
CREDIT CARD CHARGE
Amount: $590.00 Delta Flight # 49
One Way Phoenix to Dulles Date: 11/25/94
Departs 8:00AM Arrives: 3:07PM Dinner
Press on Credit Card You Want to Use.
American Express
Visa
Discover
Master Charge
Enter Your Credit Card Number
2 1 7 7 7 3 5
Enter Expiration Date (example 0 9 9 7
Month Year
Press Here to Erase Above and Repeat
Press Here to Cancel Above and Exit
Press Here to Confirm Above Charge
TV

1156

FIG. 21

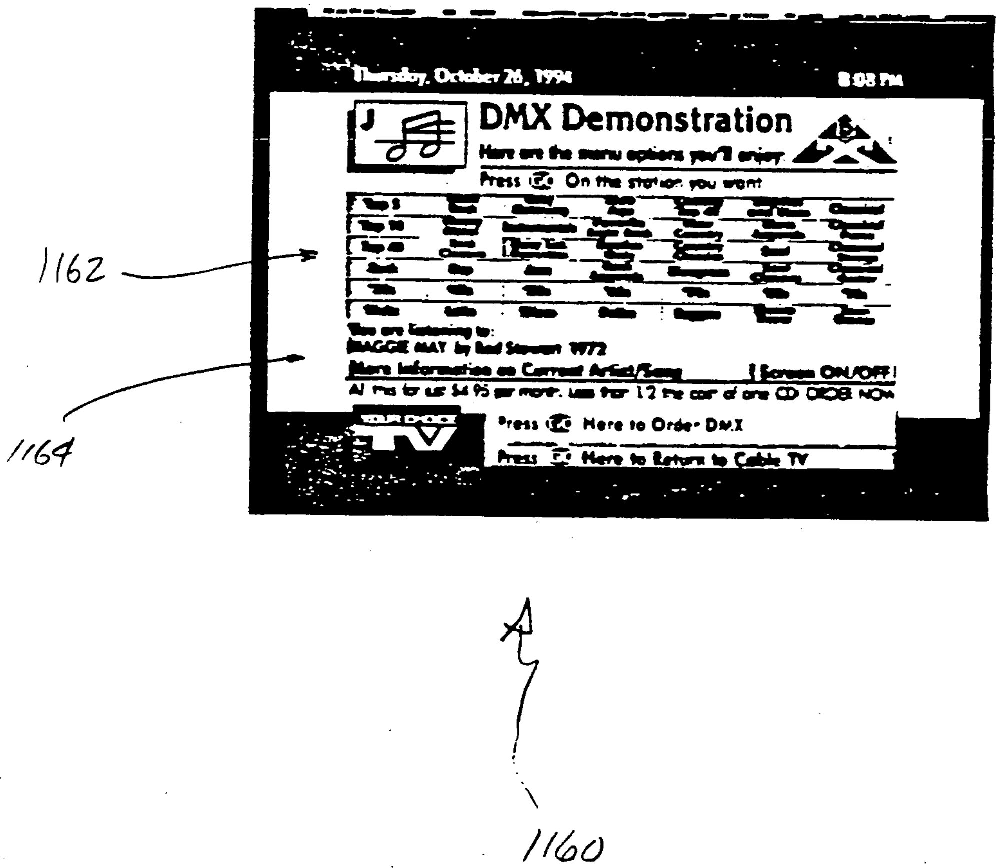
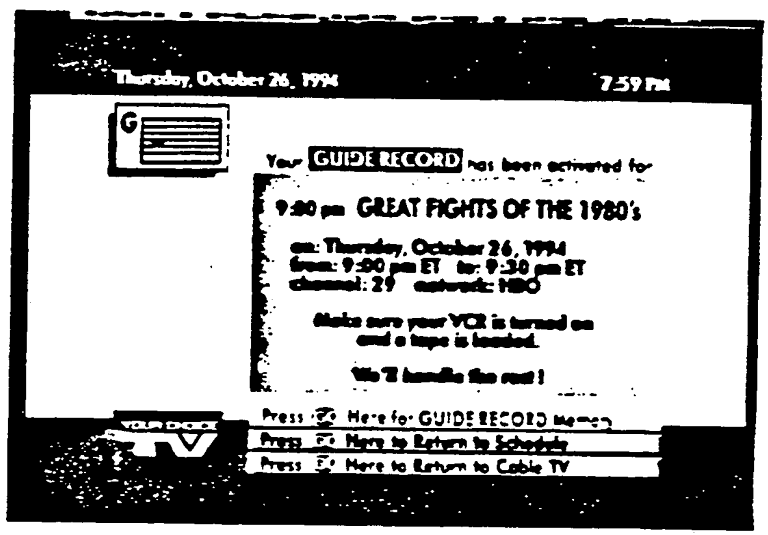

1162
1164
DMX Demonstration
Here are the menu options you'll enjoy:
Press On the station you want
You are listening to:
MAGGIE MAY by Rod Stewart 1972
More Information on Current Artist/Song
Press Here to Order DMX
Press Here to Return to Cable TV
1160

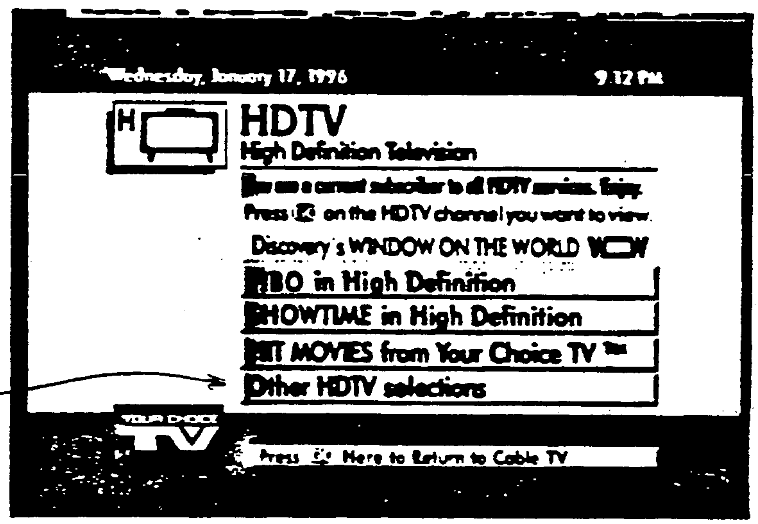
FIG. 22


Thursday, October 26, 1994
7:59 PM
Your GUIDE RECORD has been activated for
9:00 pm GREAT FIGHTS OF THE 1980's
on: Thursday, October 26, 1994
from: 9:00 pm ET to: 9:30 pm ET
channel: 29 network: HBO
Press Here to Return to Schedule
Press Here to Return to Cable TV

1170

FIG. 23

1172



1032

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 93/11606

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 H04N7/16 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 506 435 (SCIENTIFIC ATLANTA) 30 September 1992	1,10,15, 17,19, 25,40-42
A	see page 14, line 53 - page 16, line 49 --- -/--	2-9, 11-14, 16,18, 20-24, 26-39,43

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
8 March 1994	30. 03. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Greve, M

Form PCT/ISA/210 (second sheet) (July 1992)

Inte. nal Application No
PCT/US 93/11606

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JOURNAL OF LIGHTWAVE TECHNOLOGY vol. 10, no. 11 , November 1992 , NEW YORK, US pages 1760 - 1765 XP000355287 R.OLSHANSKY ET AL. 'SUBSCRIBER DISTRIBUTION NETWORKS USING COMPRESSED DIGITAL VIDEO'	1,10,15, 25,40-42
A	see the whole document	2-9, 11-14, 16-24, 26-39,43
Y	US,A,5 144 663 (KUDELSKI ET AL.) 1 September 1992	17,19
A	see the whole document	1-16,18, 20-43
A	WO,A,86 01962 (SCIENTIFIC ATLANTA) 27 March 1986 see the whole document	1-43
Y	EP,A,0 355 697 (HITACHI) 28 February 1990	34,39,43
A	see page 6, line 19 - page 18, line 23	35-38, 40-42
Y	EP,A,0 402 809 (MAGUS) 19 December 1990	34,39,43
A	see page 2, line 5 - page 5, line 5	35-38, 40-42

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 93/11606

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0506435	30-09-92	US-A-	5237610	17-08-93
		AU-A-	1384092	01-10-92
		CN-A-	1066950	09-12-92
		JP-A-	5145923	11-06-93
US-A-5144663	01-09-92	AU-B-	599646	26-07-90
		AU-A-	7157887	22-10-87
		EP-A-	0243312	28-10-87
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(71) Applicant: SCIENTIFIC-ATLANTA, INC. [US/US]; One Technology Parkway, South, Norcross, GA 30092 (US).

(72) Inventors: WOO, Arthur, S.; 38 Bournville Drive, Scarborough, Ontario M1E 1C5 (CA). SHELDRICK, Wayne, S.; Apartment 1791, 1 Greystone Walk, Scarborough, Ontario M1K 5J3 (CA). GAMMIE, Keith, B.; 51 Hawkridge Avenue, Markham, Ontario L3P 1W1 (CA). HEKIMIAN, Hrad; 32 Marblemount Crescent, Scarborough, Ontario M1T 2H4 (CA).

(74) Agents: JACKSON, Thomas, H. et al.; Banner, Birch, McKie & Beckett, 11th floor, 1001 G Street, N.W., Washington, DC 20001 (US).

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(54) Title: SYSTEM AND METHOD FOR PROVIDING COMPRESSED DIGITAL TELETEXT SERVICES AND TELETEXT SUPPORT SERVICES

(57) Abstract

A teletext system provides teletext services and teletext support services in a multiservice communication system. Multiplex data streams for a plurality of services, including teletex data, are transmitted in a sequence of frames between a transmitter location and a receiver location. Teletext information is transmitted in the format of a header packet and a data packet. The header packet contains information identifying the teletext information according to page number as well as other filter fields, such as language (filter 4), time zone (filter 2), etc. By appropriate selection of the values of the filter fields, the operator is afforded greater flexibility in providing a variety of classes of service and service support to subscribers. In addition, the system may easily be reconfigured to support the addition of services or the cancellation of services.

FIELD DESCRIPTION	SIZE (BITS)
PACKET TYPE	4
DECODER TYPE	4
ENCRYPT FLAG	1
FORWARD LINK FLAG	1
BACKWARD LINK FLAG	1
START ROW	5
START FLAG	1
BOX MODE	2
CHARACTER SET	5
PAGE NUMBER	16
FILTER ENABLE	8
FILTER 1 (SERVICE NUMBER)	8
FILTER 2 (TIME ZONE)	3
FILTER 3 (SERVICE CATEGORY)	5
FILTER 4 (LANGUAGE)	4
FILTER 5 (SECURITY ELEMENT)	1
FILTER 6	1
FILTER 7	1
FILTER 8	1
TEXT ELEMENTAL STREAM NUMBER	8
SPARE = 0	256
TOTAL	336

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SYSTEM AND METHOD FOR PROVIDING COMPRESSED DIGITAL TELETEXT SERVICES AND TELETEXT SUPPORT SERVICES

This application is related by subject matter to U.S. application serial no. 08/161,160 entitled "System and Method for Transmitting a Plurality of Digital Services Including Imaging Services" (44639-A-542) serial no. 08/160,828 entitled "System and Method for Transmitting a Plurality of Digital Services Including Compressed Imaging Services and Associated Ancillary Data Services" (44640-A-545), serial no. 08/161,840 entitled "Memory Efficient Method and Apparatus for Synch Detection" (44641-A-546), serial no. 08/161,159 entitled "A Multi-Service Data Receiver Architecture" (44642-A-547), serial no. 08/160,848 entitled "System and Method for Simultaneously Authorizing Multiple Virtual Channels" (44643-A-550), and serial no. 08/160,830 entitled "System and Method for Transmitting and Receiving Variable Length Authorization Control for Digital Services" (44643-A-554), filed concurrently herewith, and is a continuation-in-part of serial no. 08/101,974, entitled "Method and Apparatus for Uniquely Encrypting a Plurality of Services at a Transmission Site", filed August 4, 1993.

I. Background of the Invention

A. Field of the Invention

The present invention relates generally to digital signal transmission, and more particularly, to a system and method for providing digital services, including compressed teletext services and teletext support services, for selective display at a plurality of remote locations.

B. Description of the Relevant Art

With the growing trend toward a merger of the previously separate technologies of telecommunications

including voice and data telecommunications and television including satellite, broadcast and cable television, there has emerged an increased interest in developing adaptable transmission systems capable of handling any one or more of a collection or plurality of such services. The primary media investigated for providing such services to date comprise, for example, coaxial cable, land-based microwave, so-called cellular radio, broadcast FM, broadcast satellite and optical fiber, to name a few.

Each media has its own characteristics. For example, comparing cable and satellite for digital data transmission, cable tends to have a medium error rate, but, when errors appear, the errors come in long bursts. Satellite as a media has a pretty poor error rate, primarily due to the requisite weak signal power, and hence, low signal to noise ratio. In satellite, then, the poor error rate is specially corrected utilizing such techniques as convolutional error correctors, not required in a cable environment.

In copending U.S. application serial no. 07/968,846 filed October 30, 1992 and entitled "System and Method for Transmitting a Plurality of Digital Services," there is described an encoder for generating a multiplexed data stream carrying services to remote locations via, for example, a satellite or a cable distribution network. The generated data stream comprises a continuous sequence of frames, each frame comprising two fields, and each field comprising a plurality of lines. A first group of lines of a field defines a transport layer and a second group of lines defines a service data region. A feature of the disclosed scheme is the ability to dynamically vary the multiplexed data stream from field to field. A

further feature of the disclosed scheme is that the data transmission rate of the multiplexed data stream is related to the frequency of known analog video formats, i.e. frame, field and horizontal line rates.

In copending U.S. application serial no. 07/970,918 filed November 2, 1992, entitled "System and Method for Multiplexing a Plurality of Digital Program Services for Transmission to Remote Locations," there is described another system, this for multiplexing a plurality of digital program services comprising a collection of, for example, video, audio, teletext, closed-captioning and "other data" services. According to the disclosed scheme, a plurality of subframe data streams are generated, each having a transport layer region and a program data region. These subframe data streams are then multiplexed together into superframes having a transport layer region and a subframe data region.

While these disclosed transmission systems permit a variety of services to be transmitted over various media to remote locations, there remains a need to provide yet other alternative arrangements more particularly adapted to the wide variety of services that may be offered over various media and permit the end user at the remote location greater flexibility over the data content the user is ultimately enabled to receive. Moreover, such a system should be able to be easily adapted to transmit an increasing number of different services in an increasingly efficient manner, for example, utilizing the same or less bandwidth.

In such multiservice communication systems, it is desirable to provide a teletext (sometimes referred to herein as "TTX") system. TTX systems included in the broader communication system may accomplish several

functions. The TTX system may provide support to facilitate operation of the decoder by the subscriber. Such support may take the form of menu pages, help pages, and/or program guides. In addition, the TTX system should supply TTX services per se, such as stock reports, weather reports, and news. Furthermore, the TTX system should provide support for individual services included in the multiplexed signal. For example, TTX support can facilitate impulse pay-per-view (IPPV) purchases of television services or provide the current program name for television or radio services.

U.S. Patent No. 4,866,770 provides an example of a teletext system incorporated into a multiservice system. Teletext information is transmitted in a B-type multiplexed analog components (B-MAC) signal using two types of data formats: a teletext header and a text line. The teletext header contains control information and the page number of the subsequent text page. The text line contains a line of ASCII characters. The display of TTX information may be initiated by either the subscriber or by the system operator. In response, the decoder grabs the appropriate TTX page from the received signal and generates a text message therefrom. The text message is then displayed. Accordingly, the only way to distinguish between TTX pages is according to page number.

In an analog environment (e.g., B-MAC), the number of services (e.g., radio, television, TTX or data) is limited typically to less than 10 services per multiplexed signal. The TTX system is implemented by allocating a page range from a maximum, e.g. of 0-65535 (or 0000-FFFF in hexadecimal), for each specific TTX use. In one such allocation, the page range 0-1000 may be restricted to TTX support of television services. Once

the definition of page ranges are allocated, they are fixed for the life of the system. Thereafter, the configured system must support all possible services at all future times. Furthermore, there is no other way to distinguish between teletext pages except according to page number. As a consequence, every different teletext page must have a different page number, and the maximum page range serves as an absolute limit on the number of pages that may be transmitted in the system. Thus, current teletext systems are inflexible.

II. Summary of the Invention

It is an object of the present invention to provide a teletext system in a multi-service communication system having a high degree of flexibility of implementation.

It is a further object of the present invention to provide a teletext system in a multi-service communication system having a plurality of filters so that teletext pages may be may distinguished between on the basis of several criteria.

It is a further object of the present invention to provide a teletext system in a multi-service communication system that permits each service to have the maximum page range.

It is a further object of the invention to provide a teletext system in a multiservice communication system that may be dynamically configured by a system operator.

The above objects of the present invention and others are achieved by a teletext system in a multiservice communication system in which teletext service and service support are implemented through a plurality of filter fields, including a page number field, in teletext header packets. By controlling the filter values of the filter fields, the operator may

selectively provide particular teletext services and/or service support to a particular class of subscribers without being limited by page number. The present invention is highly flexible because the operator can configure the system in any way utilizing the filter fields when services are added or dropped. Furthermore, the operator may define additional filter fields or redefine existing fields as the need arises. The provision of filters expands the range of choices that the operator may make available to the subscriber.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of the attendant advantages thereof will be readily obtained as the invention becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

Figure 1 is a system block diagram showing a transmitter site 100 including an encoder and a receiver site 150 including a decoder according to the present invention for transmitting control, low data rate, medium data rate (audio) and high data rate (video) data implemented in a satellite communications system.

Figure 2A is a diagram showing a scalable multiplex frame, including synchronization words BLOCK SYNCH (also referred to herein as HSYNCH) and FRAME SYNCH, for transmitting a digital data stream of low data rate (included within PACKETS), medium data rate (audio) and high data rate (video) data protected by Reed-Solomon encoding according to the present invention.

Figure 2B is a second diagram of the frame of Figure 2A wherein the PACKETS area is further broken down into first and second regions, the first region including

packets with extra error protection and the second region including data protected only by Reed-Solomon encoding.

Figure 2C is a diagram showing that a sequence of frames in the form of Figures 2A or 2B are transmitted to a receiver according to the present invention.

Figure 3 is an encoder block diagram for one preferred embodiment of a portion of transmitter 100 of Figure 1 showing the connection of audio and video compressors and low speed data formatters to a multiplexer under control of a control computer for modulation by a modulator on to a carrier for transmission, for example, by satellite as shown in Figure 1.

Figure 4 is a detailed schematic block diagram of a multiplexer 110 of Figures 1 or 3 according to the present invention for outputting multiplexed data according to the multiplex frame format of Figures 2A, 2B and 2C.

Figure 5 depicts one preferred embodiment of a teletext header row packet.

Figure 6 depicts one preferred embodiment of a teletext data row packet.

Figure 7 illustrates a first embodiment of multiple page grab logic in the teletext system.

Figure 8 illustrates a second embodiment of multiple page grab logic in the teletext system.

Figure 9 illustrates one preferred embodiment of a filter comparator.

Figure 10 depicts one preferred embodiment of an aggregate filter comparator depicted in Figures 7 and 8.

Figure 11 depicts an example of a television service configuration according to the present invention.

Figure 12 depicts an example of a television and radio service configuration according to the present invention.

Figures 13A and 13B illustrate examples of text pages associated with the television and radio service configuration of Figure 12.

Figure 14 illustrates the teletext header row and text row packets used in implementing the text pages of Figures 13A and 13B.

Figure 15 depicts an example of a television and multiple radio service configuration according to the present invention.

Figures 16A, 16B, and 16C illustrate examples of text pages associated with the television and multiple radio service configuration of Figure 15.

Figure 17 illustrates the teletext header row and text row packets used in implementing the text pages of Figures 16A, 16B, and 16C.

Figure 18 depicts an example of a television with time zone and multiple radio service configuration according to the present invention.

Figures 19A-19D illustrate examples of text pages associated with the television with time zone and multiple radio service configuration of Figure 18.

Figure 20 illustrates the teletext header row and text row packets used in implementing the text pages of Figures 19A-19D.

Figure 21 depicts an example of a television with time zone and captions and multiple radio service configuration according to the present invention.

Figure 22 depicts an example of the scope and rights of a teletext administrator.

Figure 23 depicts an example of the scope and rights of a teletext administrator, a television manager, and a radio manager.

Figures 24A-24C illustrate text pages that may be created according to the example of Figure 23.

Figure 25 depicts an example of the scope and rights of a teletext administrator, a television manager, a radio manager, and two radio service users.

Figures 26A-26B illustrate text pages that may be created according to the example of Figure 25.

Figure 27 depicts a first example of the scope and rights of a teletext administrator, a television manager, a radio manager, two radio service users, and a television time zone user.

Figure 28 illustrates a text page that may be created according to the example of Figure 27.

Figure 29 depicts a first example of the scope and rights of a teletext administrator, a television manager, a radio manager, two radio service users, and a television time zone user.

Figures 30A-30B illustrate text pages that may be created according to the example of Figure 29.

Figure 31A illustrates an example of a template page.

Figure 31B illustrates a completed page based on the template page of Figure 31A.

Figures 32A-32B illustrate a possible page allocation for the decoder embodiment of Figure 8.

Figure 33 illustrates a possible correlation between TES # and service.

Figure 34 illustrates a possible page allocation for the decoder embodiment of Figure 9.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 shows a transmitter site 100 including an encoder and a receiver site 150 including a decoder according to the present invention applied in the environment of a satellite communications system. Audio/video compressor circuits 101(1) to 101(m) are shown for individually receiving audio service data and/or video service data, for example, from a plurality of programmers providing such services. One such MPEG video compressor known in the art is a National Transcommunications, Ltd. (England) NTL 2000 V compressor. Similarly, a plurality of low data rate services, for example, RS232 digital data, are received at low speed data formatters 105(1) . . 105(n). The audio video compressors compress the received medium and high data rate data in accordance with known algorithms (for example, in accordance with currently known or proposed standards such as MPEG I or II, audio or video, in particular, for example, ISO 11171 or ISO 13818).

Control computer 120 supplies control information, preferably as data packets, to the multiplexer 110. For example, the data packets may be constructed by the control computer according to specified formats responsive to the entry of appropriate instructions into control computer 120. Accordingly, the operator can control the various modes of authorization made available by the present invention. Furthermore, control computer 120 may generate teletext data. The teletext data may or may not be compressed.

In addition, control computer 120 controls multiplexer 110 to time division multiplex the compressed medium and high data rate streams output from compressors 101(1) to 101(m) and the low data rate streams output from formatters 105(1) to 105(n) into a serial data

stream for output to modulator 130. The high speed data link connecting multiplexer 110 and modulator 130 may be coaxial cable, optical fiber or twisted pair, so long as the transmission is relatively noise free and at sufficient data rate. In a preferred, but nonetheless nonlimiting, embodiment the control information and the data streams are encrypted. Modulator 130 then modulates the multiplexed digital data stream on to a carrier and up converts the carrier as necessary for transmission via, for example, C or Ku band frequencies through a satellite antenna 140. Modulator 130 may preferably comprise a quadrature phase shift key modulator known in the art for satellite transmission. Satellite antenna 140 beams a signal including the modulated data to satellite 160 which may be functionally referred to as a transponder. Transponder 160 simply repeats the received signal toward earth and satellite receiver antenna 151.

Receiver site 150 typically includes a tuner/demodulator 154 for selecting one of a plurality of channels to which satellite tuner/demodulator 154 may be tuned. Tuner/demodulator 154 down converts and outputs a demodulated data stream to clock and data recovery circuit 155. Clock and data recovery circuit 155 in turn outputs an error corrected data stream and synchronization data to demultiplexer 158. Additional information concerning a suitable clock and recovery circuit may be obtained from U.S. Patent Application Serial No. (Attorney Docket No. 44852-A-549), entitled "Method and Apparatus for Locating and Tracking a QPSK Carrier", filed concurrently herewith and incorporated herein by reference. A user may input a selected channel via a selector, e.g. remote control or using push buttons on a panel thereof, etc. The selector will be referred

to herein as KBD 156. The channel selection information is sent to display control processor (DCP) 153. Under the control of DCP 153, the demultiplexer 158 outputs control information corresponding to the selected channel to DCP 153.

The control information may be encrypted as discussed above. Accordingly, the DCP 153 supplies the encrypted control information to digital compression in-board security element (DISE) 157. DISE 157 decrypts the control information and determines whether the decoder is authorized to receive the selected channel. If so, the DISE 157 supplies location information and decryption information to the demultiplexer 158 via DCP 153. The demultiplexer 158 locates, demultiplexes (i.e. extracts), and decrypts the data stream and then provides the demultiplexed data streams to various output ports to subscriber equipment 159 via peripheral data processors 152. In one preferred embodiment, the demultiplexer is an application specific integrated circuit (ASIC). Further details concerning the operation of the demultiplexer 158 and the peripheral data processors 152 may be obtained from U.S. Patent Application Serial No. (Attorney Docket No. 44642-A-547), entitled "A Multi-Service Data Receiver Architecture", filed concurrently herewith and which is incorporated herein by reference. Details of a TTX processor will be discussed in greater detail below.

The user or subscriber equipment may comprise, for example, standard or high definition television reception equipment, digital audio reception equipment, digital data processors or computers, video game equipment, facsimile receiver/printers, energy management equipment and the like.

The receiver site 150 may not only be a subscriber to services but may be a provider of services such as a cable television system operator. In such a scenario, the receiver site 150 may not include typical subscriber equipment 159 but may include cable television system headend equipment known in the art including television modulators and digital audio service providing equipment and the like.

Referring now to Figure 2A, there is shown a generic frame having highly flexible characteristics. However, it will be recognized that the present invention may be practiced in connection with other data frame structures, whether they are more flexible or less flexible than that described below, without significantly diminishing the advantages of the present invention. The static or fixed elements of the depicted scalable multiplex according to the present invention are BLOCK SYNCH (or HSYNCH) and FRAME SYNC. All other depicted elements of the frame are flexible and may change from medium to medium and from frame to frame. For example, Reed-Solomon error correction parity data may be provided for satellite transmission and omitted for less error prone forms of media.

PACKETS data comprises control information as well as low speed data services, such as, for example, TTX data. Moreover, the delineation between what is shown as PACKETS data and areas for medium speed (audio) and high speed (video) data portions are flexible, and the figure is not intended to show that the boundaries between such forms of data is fixed at any one point in the frame. A predetermined structure is provided to the frame in that FRAME SYNCH follows the first byte of HSYNCH in a frame according to the present invention. PACKETS data follows

FRAME SYNCH, followed in turn by medium speed (audio) and high speed (video) data in that order.

There will always be some PACKETS data for control purposes but depending on the priorities of data services to be transmitted there may not exist low speed data portions thereof, medium speed data sections or high speed data sections of a particular frame. A more detailed discussion of the data frame structure is found in U.S. Patent Application Serial No. (Attorney Docket No. 44639-A-542), entitled "System and Method for Transmitting a Plurality of Digital Services Including Imaging Services," filed concurrently herewith and which is incorporated herein by reference. Further details concerning HSYNCH and FRAME SYNCH determination and recovery at a receiver may be found in U.S. Application Serial No. (Attorney Docket No. 44641-A-546), entitled "Memory Efficient Method and Apparatus for Synch Detection," filed concurrently herewith and incorporated herein by reference.

The term PACKETS is intended to refer to a collection of, for example, control or system data blocks which are intended to signal or control a receiver to, for example, identify the data types or data services and the respective data beginning and ending boundaries to follow. The control data blocks may serve to limit the variety of services available to an end user as well as provide a basis upon which the end user may control his receiver to receive and output data services as he chooses. In other words, according to some applications, the user's selection of services may be limited by their on-hand equipment and their preferences to particular ones of the authorized services in particular

arrangements of the various multiplexed data streams or blocks that follow in the data stream.

Low speed data refers to teletext, facsimile, conditional access, alarm, energy management, certain audio and other data streams which typically exhibit data rates of less than sixty-four kilobytes per second. Medium speed data refers to more sophisticated forms of audio such as "surround-sound" and medium speed data rates between, for example, 64 kilobytes per second and T1 carrier or D1 (telecommunications) rates of approximately one megabit per second. High speed data refers to some compressed forms of video transmission up to data rates required for high definition color television, be it in a MUSE, European, so-called Grand Alliance proposed U.S. format or other HDTV format. Such a structure is not intended to be fixed; for example, the present suggested data rates may be broken into only two regions of low and high speed data. Nevertheless, for example, low speed data will always be included within PACKETS data and precede higher speed data sections of the frame, and high speed data will always follow slower speed data and precede the first HSYNCH and FRAME SYNCH words for the next frame.

The size of a particular frame is dictated by the transmission medium and the data to be carried. One of the features of the data frame format discussed herein is a minimization of the number of bytes utilized for authorization of services and a maximization of the payload or information data portions of the frame. Thus, transmitter power and signal to noise objectives are achieved along with information payload maximization. Then, large frames are inherently more efficient, and there is an improved tolerance of long burst errors, for

example, in a cable or satellite environment. Other factors weigh against the choice of too large a frame. These include the speed of achieving synchronization at a receiver and the cost of error correction circuitry such as memory costs at a receiver site.

In an error-prone environment, error protection is provided by a Reed-Solomon block code denoted REED-SOLOMON and appearing in Figure 2A as a narrow but long rectangular column at the right of the figure. As is shown in either Figure 2A or 2B, the Reed-Solomon block code is appended to the information data bytes as forward error correction (FEC) parity bytes. The proportion of FEC bytes to information bytes is on the order of from one to ten per cent depending on the particular medium or mixture of media or application. Interleaving, wherein bytes of a number of blocks grouped in the depicted frame are shuffled between blocks according to a predetermined algorithm known to transmitter and receiver alike, may be employed to provide additional protection against extended bursts of errors. Further information concerning interleaving may be found in U.S. Patent Application Serial No. (Attorney Docket No. 44639-A-542), entitled "System and Method for Transmitting a Plurality of Digital Services Including Imaging Services," filed concurrently herewith and which is incorporated herein by reference.

A nearly square, but not perfectly square, frame is preferred and thus the practical maximum limit on the vertical dimension is about 512 lines or blocks. In keeping with such considerations and practical limitations on typical media bandwidths, a practical maximum number of video services is on the order of thirty-two and on concurrent audio services, sixty-four,

assuming video and audio data compression is utilized without greatly sacrificing received signal resolution.

PACKETS data follows the FRAME SYNC word in the frame. Certain PACKETS data is utilized to identify the number of bytes provided in a frame for a particular service when byte stuffing is required. Referring to Figure 2B, the PACKETS data portion of the multiplex frame may be said to further consist of two regions: one region including a MUX Structure Control packet requiring additional forward error correction and a second region requiring now additional forward error correction than the Reed-Solomon coding provided for each row or line (excluding HSYNCH).

Other categories of PACKETS data do not require additional forward error correction. These include video and audio control, seed packets for decryption, cyclic system data, composite virtual channel and definition packets for providing what may be perceived as additional data services, addressed data packets for transmitting messages to addressed decoders, teletext and utility data packets and other service packets. Additional details of the various PACKETS data may be obtained from U.S. Patent Application No. (Attorney Docket No. 44639-A-542), entitled "System and Method for Transmitting a Plurality of Digital Services Including Imaging Services," filed concurrently herewith and which is incorporated herein by reference, and U.S. Patent Application Serial No, (Attorney Docket No. 44643-A-554), entitled "System and Method for Transmitting and Receiving Variable Length Authorization Control for Digital Services", filed concurrently herewith and which is incorporated herein by reference.

Figure 2C illustrates that a sequence of frames in the form of Figures 2A or 2B are transmitted to a receiver according to the present invention. The sequence of frames need not be composed of identical allocation of packets, low speed data, etc. Rather, the content of individual frames may altered by the operator in accordance with the services and authorization control desired.

Now, an encoder according to the present invention will be further described with reference to Figure 3. It has already been described that an encoder according to the present invention typically involves A/V compressors 101(1) to 101(m). Particular suggested capacities for one such A/V compressor, for example, compressor 101(1) are to limit the number of input video streams to 1 and to provide up to a maximum of four audio input streams (or two stereo streams) each comprising left and right input streams.

It has also been described that low speed data formatters 105(1) to 105(n) be provided. Typically, however, each low speed data formatter may handle, for example, sixteen or even thirty-two input data streams. Consequently, it is contemplated that the number of such formatters required will number only 1 or 2. However, any number of low speed data formatters may be implemented consistent with the principles of the present invention. Low speed data formatters typically receive low speed data in a predetermined format, such as RS232, and strip the data of any header data, start data, stop data, parity data and such depending on the predetermined and identified input data stream so that only true information carrying data remains in a serial data stream.

Now, the multiplexer 110 of Figure 3 will be described in further detail with reference to Figure 4. Audio/video service streams A1 to An are received from audio/video compressors at audio/video data buffer 410. Service multiplexer 110 operates to multiplex a plurality of digital service streams for transmission to remote locations. Also shown are inputs to a low speed data buffer 412 from low speed data formatters 105(1) to 105(n). Buffer 410 (audio/video) and buffer 412 for low speed data preferably signal a buffer fullness condition to the next functional element, for example, encryption block 415, if encryption is desired, or on to multiplex frame formatter 418 for low speed data. Encryption block 415 is intended to represent the inclusion of, for example, single or double tiers of encryption in accordance with seeds and keys and particular, predetermined algorithms as required for the digital service streams, for example, in a pay environment.

Other digital data is input from a text/graphics input computer, for example, teletext data to text data processor 416 via computer interface 414 to the service multiplexer 418. Conditional access data is input, for example, from a billing computer or subscriber service computer for storage in conditional access data buffer 417. Conditional access data typically defines the services, especially pay services, to which a subscriber has subscribed. This data interfaced also via interface 414 is processed and packeted into protect region 1 PACKETS via conditional access data processing block 417 for input to multiplex formatter 418.

Thus, at the output of multiplex (MUX) block 418 is a multiplexed frame structure as described by Figures 2A, 2B and 2C. The output digital stream is Reed Solomon

encoded according to an appropriate encoding scheme depending on the noise characteristics of the transmission media by a well known Reed Solomon encoder 454. Then, preferably in a highly noisy environment, the frame is interleaved on a byte(s) (rows and columns switching) basis at interleave block 462. Interleave circuit 462 interleaves the data frame by transposing row and column addresses of data within the frame. Lastly, HSYNCH and FRAME SYNCH are inserted into the frame just prior to transmission at synch insert block 458. This data then appears at a receiver at its original location in the frame while all other data is interleaved.

The format of the TTX information will now be described. The TTX system supports two types of TTX packets: a header row packet and a data row packet. The header row packet defines the characteristics of the data row packet(s) that follow it. In a preferred embodiment, the data row packet comprises 40 8-bit characters. Of course, the present invention is not limited in this respect. One of skill in the art will recognize that an alternative number of characters as well as an alternative number of bits per character can be implemented.

Figure 5 illustrates a preferred configuration of a header row packet. The specific fields and bit allocation should not be considered to limit the present invention. The PACKET TYPE field identifies the packet as a teletext header packet. Accordingly, a filter (not shown) in the demultiplexer 158 can extract a TTX header packet from other data. DECODER TYPE enables "filtering" based upon decoder type in the event that different types of decoders are used in the system. The concept of filtering in connection with the present invention will

be discussed in greater detail below. The ENCRYPT FLAG indicates whether the page is encrypted or not. Accordingly, the decoder can determine whether or not to decrypt the teletext data by the ENCRYPT FLAG. The FORWARD LINK FLAG and the BACKWARD LINK FLAG indicate respectively whether the page is forward and backward linked. A value of "1" for any of ENCRYPT FLAG, the FORWARD LINK FLAG, and BACKWARD LINK FLAG may represent enablement of the feature and a value of "0" may represent a disablement of the feature. Of course, it will be recognized that any particular protocol is acceptable so long as the transmitted information is properly understood at the decoder.

The BOX MODE indicates whether or not a page is displayed on the subscriber's viewing screen in a box. If a page is boxed, the portion of the screen surrounding the text may be specified to be black or video. In one preferred embodiment, two bits are assigned to BOX MODE. Of the two bits, a BOX ENABLE bit indicates whether BOX MODE is enabled and a BOX BACKGROUND bit indicates whether the background is black or video.

As pages are placed onto transmission an increasing portion of TTX bandwidth is occupied. This is particularly true where teletext support of multiple services is provided. As a result, the grab time for specific pages is increased. The START ROW field reduces the number of rows that are required to be transmitted per page by specifying the first non-empty row. Accordingly, transmission bandwidth need not be wasted transmitting the empty rows at the top portion of pages such as, for example, caption pages which usually only have a single row of text near the bottom of the screen.

START ROW further implements a page annotation feature of the present invention, which reduces the transmission requirements for pages that have empty rows embedded within text rows. In addition to indicating the first non-empty row of text, START ROW indicates the row in which all subsequent text rows are to be placed. Therefore, empty rows between rows of text on a page may be omitted by including a second header row packet with the new START ROW. The annotation header row packet is differentiated from the page header row packet by a single bit START FLAG. When START FLAG is, for example, "1", the header is a page header indicating that a new page is about to be received and all page memory should be cleared. Any subsequent headers with START FLAG having a value, for example, of "0", are annotation headers and cause all subsequent text rows to be annotated onto the page in the appropriate row indicated by START ROW. Thus, START FLAG signals whether the particular page is a new page or an annotation page. Examples of the use of the START ROW and START FLAG fields in connection with start pages and annotation pages are provided below.

One of a plurality of character sets (e.g., 32 in one preferred embodiment) may be selected using the CHARACTER SET field. The PAGE NUMBER field enables the decoder to select pages of text according to page number. Thus, the transmitted PAGE NUMBER can be used to filter a transmission so that only the requested page of text is grabbed. Accordingly, PAGE NUMBER may be considered a filter field for purposes of the present invention.

One preferred teletext header that includes eight aggregate filter fields (also referred to herein as filter fields) will be discussed below. However, the

number of aggregate filter fields may vary depending on the requirements, for example, of the operator, the system, or the subscriber. The eight general purpose aggregate filter fields FILTERS 1-8 are available to allow the broadcaster and decoder to selectively screen the teletext pages. These eight fields may be defined by the broadcaster as desired. Each aggregate filter field has an associated value.

By way of example, several preferred uses of the filter fields are discussed below. FILTER 1 may be a service number filter having, for example, an 8-bit value for allowing pages to be designated for specific services within a service category (e.g., TV service #1 may have a different teletext page than TV service #2). FILTER 2 may be a time zone filter having, for example, a 3-bit value that allows time zone specific data to be retrieved by the decoder. The broadcaster may specify that any text page is time zone specific at the time of broadcast. For example, the broadcaster may wish to transmit text reporting a 3:00 PM Eastern Standard Time start time of a particular show for display only at televisions within the region using Eastern Standard Time. If FILTER 2 is not enabled (i.e., the text is not time zone specific), the text page will be grabbed by decoders regardless of the time zone. When enabled, the encoder could use an additional header to annotate the time and date row onto a previous time zone independent page of text. The time zone of the decoder may be programmed into the DISE, and may be changed by the broadcaster using an addressed data packet (ADP) specific to the decoder.

A text page may be further designated according to service category, for example, TV, radio, data, etc., using FILTER 3. FILTER 3 has 5-bits in the instance

illustrated in Figure 5. By way of example, a TV service may have a specific black out page which is different from radio, data, or text blackout page. By enabling FILTER 3 and assigning each service category a specific code, a TV service specific black out page can be achieved.

FILTER 4 and FILTER 5 may be used to designate information specific to language or security element using, for example, 4 bits and 1 bit, respectively. A subscriber may enter a desired language for service in the decoder via a keyboard. Moreover, each decoder may have a decoder type definition programmed as a fixed value in its decoder internal security element (DISE). Accordingly, the decoder filter field would be responsive to the programmed decoder type definition. By using FILTER 4 and FILTER 5, the text page would only be displayed at decoders having a matching language and security element filter. Additional FILTERS 5-8 may be used for other purposes selected by the broadcaster. Alternatively, one or more FILTERS could be reserved for future purposes.

A powerful advantage of the present invention is the ability to combine filters to enable the broadcaster to control which subscribers receive a particular page of text. For instance, a page of text may represent a video black out page for display by French language, Eastern Standard Time decoders. Alternatively, menu pages that are common to all services and time zones may be transmitted.

A FILTER ENABLE byte is preferably included to indicate which of FILTER 1-8 are enabled. For example, FILTER ENABLE may have a bit that corresponds to each of the available filters. A "1" may indicate that a

particular filter is activated and a "0" may indicate that the filter is disabled, or vice versa. When a FILTER ENABLE bit indicates that the corresponding filter is activated, the teletext page will be grabbed only if the value in the designated FILTERS 1-8 match a corresponding filter value stored in the decoder. When a FILTER ENABLE bit indicates that the corresponding filter is disabled, the teletext page is grabbed if all other enabled filter values match. Of course, the FILTER ENABLE field may be implemented in numerous other ways.

A TEXT ELEMENTAL STREAM NUMBER field is used by the encoder to indicate the physical text service number used for encryption. The physical text service number, encryption, and decryption will be discussed further below. This field is ignored when the ENCRYPT FLAG indicates that there is no encryption. The decoder may use the TEXT ELEMENTAL STREAM NUMBER field to determine seed validity if required.

FIGURE 6 illustrates one preferred embodiment of a teletext data row packet. The PACKET TYPE field identifies the packet as a teletext data row packet. Accordingly, a filter (not shown) in the demultiplexer can extract a teletext data row packet from other data. DECODER TYPE enables filtering based upon the type of decoder. The remainder of the teletext data row packet may be allocated for teletext data. For example, 40 8-bit characters (i.e. 320 bits total) may comprises a teletext row. However, this is intended merely as an example. The number of total bits (which would determine the number of characters if the number of bits per character were fixed) and the number of bits per character may vary in accordance with the present invention.

The encoder may be configured to construct the TTX header and data row packets as discussed above. The reception of TTX information by the decoder will now be discussed. The demultiplexer 158 determines whether a received packet is a teletext packet (TTP) as opposed to another packet according to its packet type information. The entire TTP is extracted from other packets and is transmitted to a Micro-processor and Teletext (PMS) section of the demultiplexer 158. One of the functions of the PMS may be to perform multiple page grabs of teletext pages. The PMS must be able to handle the maximum data rate without losing any data. It is preferred that all TTPs have the same length. Difficulties handling the received TTPs having different lengths may arise if the demultiplexer 158 expects the header in a specific location.

The demultiplexer 158 compares the page number of the header row packet with a requested page number. A particular page number may be requested as a consequence of a subscriber's channel selection, for example, or automatically by the decoder upon the occurrence of an event. If the requested page number is found in the received data, the text data packets that follow the header row packet are written into a memory, e.g. a random access memory (RAM), until a new header packet is received. The demultiplexer 158 can store 16 text pages including header row data and have four page number comparators in one exemplary embodiment. When a page has been received and written to RAM, a page grabbed status flag will be set for the DCP 153.

The DCP 153 command structure may comprise a page grab command, page number, compare register number (e.g., 0-3), and RAM page to write to (e.g., 0-15). Status read

commands return the current status for the outstanding page grabs and thereby permit the DCP to monitor the status of page grabs. The DCP 153 and the demultiplexer 158 have access to the text header flags using a Read RAM command.

The text header may also include filter values for category, service, time zone, language, security element, etc. Each of these fields can be enabled or disabled via the filter enable flags. The demultiplexer 158 sets a row counter to the starting row number in the header row packet. The demultiplexer will not modify current data in the previous text rows to ensure proper page construction. If the text page requires space characters in the previous rows, either the encoder may transmit a full page or the DCP may issue a clear page command. The demultiplexer then checks for page overflow to ensure that is does not write into the next text page in RAM.

Row annotation and filtering may cause pages to be reconstructed row by row in no particular order. A single row may be erased, created, and overwritten before a page is reconstructed. If a page is also being displayed at the same time it is reconstructed, the display may behave erratically. While reconstruction is in progress, rows may appear, disappear, and then re-appear with different data. The rate at which this occurs depends on the number of annotation rows required to construct the page.

To avoid this difficulty, the DCP 153 may implement page swapping thereby ensuring that reconstruction and display of a page do not interfere with each other. The DCP 153 may request page grabs only to a RAM that is not on display. Once the page has been grabbed, the demultiplexer 158 must discontinue grabbing the page and

inform the DCP 153 that a grab is completed. The DCP 153 can then cause the completely reconstructed page to be displayed and initiate another grab into a non-displayed RAM. By reissuing the grab, the DCP 153 implements a continuous grab.

The demultiplexer 158 must be capable of automatically stopping a page grab as soon as a page has been reconstructed. If it were to continue to grab the page, the DCP 153 could cause the page to be displayed while it is being reconstructed. The indication to the DCP 153 that the page grab has been completed should only be set when a complete page has been reconstructed. This is indicated in the demultiplexer 158 by a matching header row (i.e., a header row having the correct page number and filter values) with the START FLAG set followed by another header row with a START FLAG set.

The ENCRYPT FLAG indicates that the current annotation page is encrypted. Without limiting the invention, the encryption may be conducted on an annotation page by annotation page basis. Encryption may be performed only on data rows following the header row, and a complete page may consist of encrypted and non-encrypted rows. The DCP 153 will load the text decryption seed every session. When the demultiplexer 158 finds the page header, it loads the current text seed for the session and decrypts the entire page. Accordingly, the text data may be stored in the clear in the RAM.

The display support, logic used to display a page onto a television screen, for example, controls the text data to be sent to the character generator. It also controls the display attributes requested by the DCP 153 or from the TTX header row packet. The character set

number allows selection from several font ROMs. For example. a 5-bit number may be used as upper address bits in addition to an 8-bit text data. Thus, the CHARACTER SET field of the header row packet may form part of an address for retrieving a particular character in a particular font from ROM.

Figure 7 illustrates an exemplary embodiment of multiple page grab logic 700 of a demultiplexer 158. The multiple page grab logic 700 comprises page grabbers 710-1 to 710-n, page display logic 750, and page display random access memory (RAM) 760.

After extraction from the multiplexed signal in another portion of the demultiplexer 158, a received TTX header row packet 705 is sent to each of the page grabbers 710-1 to 710-n. However, different page grabbers may grab different pages according to the requested page and/or requested filter values supplied thereto by the DCP. Different requested page and/or requested filter values may be applied to each page grabber in order to control the page grabbers to grab different pages. Each of the page grabbers 710-1 to 710-n may be identical in structure and operation. Accordingly, the description of the operation of page grabber 710-1 below is equally pertinent for any of the other page grabbers and a specific discussion of page grabbers 710-2 to 710-n will not be provided herein.

Page grabber 710-1 comprises a page comparator 715-1, AND logic circuit 720-1, aggregate filter comparator 725-1, page grab logic 730-1, decryptor 735-1, and page construction random access memory (RAM) 740-1. The AND logic circuit 720-1 and the page grab logic 730-1 may together be considered a page grab logic circuit. Assuming that the received TTX header row packet is

supplied to page grabber 710-1, the PAGE NUMBER field is supplied to the page comparators 715-1 where it is compared to a requested page number. The page comparator outputs a matching signal to an AND logic circuit 720-1 on the basis of the comparison to indicate whether or not a match occurred. In addition, the FILTER field and the FILTER ENABLE field of the received TTX header row packet are supplied to an aggregate filter comparator 725-1. The aggregate filter comparator 725-1 compares the FILTER field values with requested filter values and compares whether the particular filter is enabled at all. The aggregate filter comparator 725-1 outputs a matching signal to AND logic circuit 720-1 on the basis of the comparison to indicate whether or not a match occurred. Details concerning the determination of an output value for an aggregate filter comparator are provided below in connection with Figures 9 and 10.

If, for example, both the page comparator 715-1 and the aggregate filter comparator 725-1 indicate a match, the AND logic circuit 720-1 outputs a first signal, e.g., a "1", to the page grab logic 730-1. If, however, either the page comparator 715-1 or the aggregate filter comparator 725-1 do not indicate a match, the AND logic circuit 720-1 outputs a second signal, e.g., a "0", to the page grab logic 730-1.

In addition to receiving the output from the AND logic circuit 720-1, the page grab logic receives various other fields of the received TTX header row packet, such as PACKET TYPE, START FLAG, and START ROW. The TTX data stream, which may be comprised of the data row packets, is decrypted in decryptor 735-1 and then supplied to the page grab logic 730-1. The page grab logic 730-1 determines on the basis of the signal from the AND logic

circuit 720-1 whether the received TTX header row packet describes a teletext information it should grab. If not, the next TTX header row packet is interpreted.

If TTX header row packet describes teletext information that should be grabbed, the page grab logic 730-1 implements a state machine that is used to maintain the page construction in page construction RAM 740-1. After extraction from the multiplexed signal by a portion of the demultiplexer, TTX data stream is applied to the multiple page grab logic 700. Page construction RAM 740-1 is constantly updated with data from the TTX data stream that is supplied via the page grab logic 730-1. As the TTX data stream is received, the header row packet is interpreted by page comparator 715-1, aggregate filter comparator 725-1, and page grab logic 730-1. The information from the header row packet 705 is used by page grab logic 730-1 to generate read/write commands, RAM enable commands, and address information that place subsequent data rows into the correct address in page construction RAM 740-1 to form the portion of the teletext page defined by the teletext header row packet.

Update of the page construction RAM 740-1 stops when the requested page is completely grabbed. At this time the page grab logic 730-1 sends a "grab complete" signal to page display logic 750. The grab logic 730-1 then releases control of the page construction RAM 740-1. The page display logic 750 controls the page construction RAM 740-1 using read/write commands and RAM enable commands to copy the page into page display RAM 760. The constructed page may then be displayed from page display RAM 760. For example, a character generator may read the data out of RAM 760 and access corresponding pixel data in a ROM (not shown). The character generator must

generate the appropriate address information to access the RAM and ROM.

This implementation of multiple page grab logic 700 offers maximum flexibility since each page is supplied with the complete set of logic required to grab that page. As a result, each page grab does not affect any others.

Figure 8 depicts an alternative embodiment of multiple page grab logic. The multiple page grab logic 800 includes page grabbers 810-1 to 810-n, aggregate filter comparator 825, decryptor 835, page display logic 850, and page display RAM 860. Page display logic 850 and page display RAM 860 operate in the same manner as described in connection with Figure 7. Each page grabber includes a page comparator 815-1, AND logic circuit 820-1, page grab logic 830-1, and page construction RAM 840-1. As above, AND logic circuit 820-1 and page grab logic 830-1 may together be considered to form a page grab logic circuit. Each of the page grabbers 810-1 to 810-n share an aggregate filter comparator 825 and a decryptor 835. As a result, multiple page grabs can only be achieved if each page to be grabbed is encrypted in the same way and has the same filter settings. The multiple page grab logic 800 otherwise functions in a similar manner to multiple page grab logic 700.

In the above description, any number of page grabbers may be implemented. For example, four page grabbers may be used in one preferred embodiment.

Figure 9 depicts an example of a single filter comparator 900 that may be used in aggregate filter comparator 725-1 to 725-n and 825. The single filter comparator 900 comprises an n-bit comparator 910 and an OR logic circuit 920. The n-bit comparator 910 receives

an n-bit filter value from the received TTX header row packet and an n-bit filter requested value. As discussed above, the filter requested value may be input by the subscriber or read out of a memory in the decoder. The filter requested values may have been read into the memory pursuant to an instruction from the operator, the subscriber, or on the basis of the hardware implemented by the decoder. The n-bit comparator 910 outputs a first signal, e.g. "1", if the received filter value matches the requested filter value and outputs a second signal, e.g., "0", if there is no match.

The OR logic circuit 920 receives the output of the n-bit comparator at a first input terminal and receives a filter enable bit from the received header row packet at an inverted second input terminal. The OR logic circuit 920 will output a matching signal indicating a "filter match" if either the filter is disabled or if the n-bit filter value matches the n-bit filter requested value. Otherwise, the OR logic circuit will output a "filter not matched" signal. Of course, it should be clear that OR logic circuit may be replaced with other logic circuits to produce the similar results if the protocol used by the n-bit comparator 910 and/or the filter enable bit were different.

Figure 10 illustrates a specific embodiment of an aggregate filter comparator 1000 such as that depicted as 725-1 to 725-n in Figure 7 or 825 in Figure 8. The aggregate filter comparator 1000 is shown as comprising eight separate filter comparators 1010-1 to 1010-8 and an AND logic circuit 1020. Each filter comparator 1010-1 to 1010-8 may be of the type depicted in Figure 9. Of course, the use of eight filter comparators is intended as an example, and any number of separate filter

comparators may be implemented consistent with the present invention. Each filter comparator 1010-1 to 1010-8 receives corresponding filter values, a filter enable value, and filter request values. Figure 10 provides an example of the number of bits received by each filter comparator. However, the number of bits shown is intended to match the TTX header row packet shown in Figure 5 and should not be considered limiting. The output of each filter comparator 1010-1 to 1010-8 is supplied to an input terminal of AND logic circuit 1020. The AND logic circuit 1020 outputs a matching signal indicating "aggregate filter match" or a signal indicating "aggregate filter not matched."

As discussed in connection with Figure 9, if an individual filter comparator 1010-1 to 1010-8 detects that either the filter is disabled on the basis of the filter enable signal or that the filter values match the requested filter values, it outputs a "filter match" signal, e.g. "1". Otherwise, the filter comparators 1010-1 to 1010-8 output a "filter not matched" signal, e.g. "0". Thus, the AND logic circuit 1020 outputs an "aggregate filter match" signal if each individual filter comparator 1010-1 to 1010-8 outputs a "filter match" signal. If, however, any one of filter comparators 1010-1 to 1010-8 outputs a "filter not matched" signal, the AND logic circuit 1020 will output a "aggregate filter not matched" signal. As above, AND logic circuit 1020 may be replaced by other logic circuits depending on the signal protocol used.

The configuration of the digital multiplex allows for dynamic creation and deletion of virtual channels. The filters of the TTX system allow the broadcaster to dynamically configure the TTX according variety of

classifications, for example, language, service category, service number, time zone, and security element. Of course, the TTX system may be configured based on other distinctions that the broadcaster may find desirable. It is important to understand that the filters are definable by anyone who operates the system. Accordingly, the operator may use the filters to control which subscribers receive particular text and which subscribers do not.

Furthermore, by constructing appropriate TTX pages, the TTX system of the present invention is capable of offering the following functions: network control including menu, help, and decoder authorization status pages; teletext programs, which are primarily teletext program offerings, for example stock reports, weather reports, etc.; teletext for non-teletext programs such as teletext captioning or business television (BTV) type teletext; broadcast or general messages, for example broadcast of a teletext page to all decoders; transmission of personal messages such as teletext pages targeted to a specific decoder or group of decoders; and an electronic program guide.

The decoder is such that it always attempts to specify a requested page using the finest "granularity." In other words, the demultiplexer will attempt to grab a page using the highest specificity of requested filter values, such as specific language, specific service category, specific service number, specific time zone, specific security element, etc. A filter allows the broadcaster to dynamically override the requested filter values by proper selection of filter values in the transmitted signal.

At the encoder, each TTX page may tagged as specific (i.e., filter enabled) or global (i.e., filter disabled)

for each of the filters. A global page is grabbed by the decoder no matter what the filter values are. In other words, the filters are disabled for a global page. A specific page is grabbed only by decoders that have matching filter values. By selectively transmitting global or specific pages, the broadcaster may control what gets displayed by a decoder when it grabs a page.

Furthermore, the operator can reconfigure the filter by creating pages that allow a subscriber to make a selection. For example, a operator can allow subscribers to select between Spanish language and English language text by creating a menu page inviting the subscriber to make a selection. The transmitted Spanish page can be transmitted with a different filter value than the English page. Responsive to the subscriber's selection, the page grab logic will grab the page having the selected filter value.

The following examples are designed to illustrate the operation of a filter system for implementing a tiered television service network. In a simple case, the network comprises one television service that is authorized by tiers. No other authorization features (such as blackout, per-per-view (PPV), impulse pay-per-view (IPPV), free time, etc.) are supported. The minimal TTX support may consist of the following three TTX pages: "No KOM" (KOM refers to the "key of the month" which is a basic authorization control); "Service Tier Not Authorized"; and a main menu. All filters would be disabled for these pages thereby allowing every decoder to receive them.

Figure 11 illustrates the network consisting of one television service having the three TTX pages. Each column represents a filter, in this case service

category, service number, and time zone. Of course any number and type of filter may be added depending upon the type of classification the operator wishes to set up. The global column represents the condition where the filters are disabled. Figure 11 may be considered to represent the situation where other available filters are disabled.

Figure 12 illustrates an example where a single radio service is added to the network of one television service depicted in Figure 11. The TTX configuration may be modified to allow for both television service and radio service categories. While the "No KOM" and "main menu" pages remain global pages, a "Radio Authorized" page is created and the "Service Tier Not Authorized" page is made into two pages: a "TV Service Not Authorized" page and a "Radio Service Not Authorized" page. The creation of the category specific "Service Not Authorized" pages is accomplished by creating the two pages and enabling the category filter accordingly.

The "Service Not Authorized" pages may be created in several ways. The simplest way is to create two independent images for the two pages. While more complicated, it is more efficient in terms of transmission bandwidth to create a global "Service Not Authorized" template page and two annotation pages that are particular to the services. The global template page would hold the portion of the page that is common to both service categories, for example, "You Are Not Authorized For." The annotation pages hold the TTX rows that are specific to the service, such as "The Prime Movie Channel" for the television service category or "Easy-Listening Radio" for the radio service category. An example of such pages is depicted in Figures 13A and 13B.

A third way to create the "Service Not Authorized" pages is to create a global page that is specific to one of the service categories, e.g. a "The Prime Movie Channel Is Not Authorized", and create annotation rows that overwrite the television specific portions of the global page with radio specific text. Accordingly, the global page acts as a default page in the event that a specific selection is not made by the system operator.

With reference to Figures 13A and 13B, it can be seen that row 8 contains the common row and therefore constitutes the global category page. It is marked as protected on the global level in the left column, and thus cannot be changed by operators authorized only to create pages for television or radio. All other rows may be filled with category specific text. In the examples of Figures 13A and 13B, only row 9 holds category specific text.

The transmission of the pages for Figures 13A and 13B require only six (6) rows of TTX: a header row and a data row for the global category, a header row and a data row for the television category, and a header row and a data row for the radio category. A format for the TTX rows is illustrated in Figure 14.

Figure 15 illustrates the example where multiple radio services are provided. The creation of two or more radio services may be supported by using a service number filter. In the example of Figure 15, the "Radio Authorized" page has been left as a radio category global page. Therefore, any authorized decoder tuned to a radio channel will get the same page. The "Radio Authorized" page could easily be made radio service specific by applying the service number filter to the page.

The "Radio Not Authorized" page is specific for each of the radio services, in this example, three as shown in Figures 16A-16C. In each page, row 7 is protected as a global row. Row 11 is a radio category specific row and is, thus, common to all radio category pages. Row 9 contains the radio service specific text. Transmission of the TTX support for the configuration depicted in Figures 15 and 16A-16C requires twelve (12) rows of TTX. The twelve (12) rows of teletext are depicted in Figure 17.

Figure 18 depicts the example of Figure 15 with the addition of television service time zone information. The television "Service Not Authorized" page is received by all decoders not authorized for television. In this example, the information presented in the television "Service Not Authorized" page could contain the start time of the next television program. Accordingly, the user would be prompted to try again at later time. However, the start time of the next television program may be different depending on the time zone in which the decoder is located. The local time for a particular decoder is displayed in the ideal case. A time zone filter may be used to implement local time display across a variety of time zones.

Because there is only one television service in the present example, there is no need for a service number filter for the television service category. Accordingly, the service number filter for the television category may be disabled. It should be clear that if several different television services were implemented, a service filter for the television category may be easily implemented. In the present example, however, the time

zone filter is set for each time zone that is supported as illustrated in Figure 18.

Figures 19A-19D illustrate the individual TTX pages that may be created. As in the above examples, row 7 in each of Figures 19A-19D remains global, rows 9 and 11 are category specific, and row 12 is time zone specific. Figure 20 illustrates the various rows of information used to transmit. In all, twenty-two (22) rows are required to transmit the "Service Not Authorized" page for all categories, services, and time zones.

Figure 21 illustrates the example of Figure 18 with the addition of a closed captioning to support, for example, foreign languages. Line 21 captions (i.e., captions which appear on line 21 of the displayed television signal) allow support of dual language closed captions. The availability of such closed captioning can be facilitated by enabling a language filter. In the previous examples, the global pages were said to be available to all decoders without restriction. However, if a language filter is implemented, all pages would be available to all decoders without restriction only if the language filter was also disabled for all pages. An operator may choose to provide full dual language support by creating all of the required TTX pages for the second language and setting the dual language filter appropriately. Alternatively, English may be used as a default global language and the alternate language alone can be supported with closed captioning. Thus, all pages would be in English with only the caption page selectable to the alternative language. The latter example is depicted in Figure 21.

The system of TTX support for multiple virtual channels requires operator maintenance. Accordingly, it

is therefore convenient for operators bestow limited authority on maintenance persons, hereinafter referred to as users, to perform network maintenance functions. It should be noted that "users" in this context differs from "subscribers" to whom the services are provided. In an embodiment of the present invention, a user is defined with a user name and privileges. The user name identifies the user to the system. Privileges define the user's responsibilities. Privileges may have two components: scope and rights. Scope is the segment of the network available to the user. The rights define what actions the user is permitted to take in the available network.

For example, a user may have the right to VIEW, EDIT, or CREATE. VIEW rights only permit the user to read data. EDIT rights allow the user to read and modify any data within the user's scope. The CREATE right allows the user to view and edit data, as well as set filters to any value within the user's scope.

The scope may be specified based on the filters. Each scope filter may be set to the following values: GLOBAL, ALL, or a list of specific filter values. The setting of a scope for a user defines which set of page filters are accessible, not what the page filters are themselves set to. Therefore, page filters and scope filters as used herein must be distinguished. As noted above, scope filters define the list of accessible page filters. The user's scope consists of all data that pass the scope filters. When a filter is set to GLOBAL, only data that has the filter disabled will pass. A filter set to ALL will permit all data to pass. A filter set to specific values will only allow data with the filter disabled or with the specific filter values to pass.

The following example illustrates how users can be created. It is assumed that a network has a single television service. Each system will have a TTX administrator will full privileges as illustrated by the definition shown in Figure 22. Because the only service offered is television service, only the TTX administrator is required. The TTX administrator creates complete pages. There is no reason to restrict access because there are no other users.

Figure 23 illustrates the example of Figure 22 where a single radio service is added. The addition of the radio service can be accommodated by creating a user to manage the television service and a user to manage the radio service. The television manager is assigned all television related responsibilities. Accordingly, the risk that the TTX administrator accidently modified radio service data when accessing television related data is reduced.

As can be seen from Figure 23, the TTX administrator can disallow modification of language dependent data by the television manager and the radio manager by defining their scope and rights in connection with the language filter as GLOBAL and VIEW, respectively. All data has the language filter disabled for this example, and the TTX administrator has reserved the right to create new languages and has restricted the rights of the radio and television managers thereto. Both managers are given view rights to language data to thereby allow them to retrieve pages.

The managers have been given CREATE rights to their respective categories. This allows them to modify and create category specific data for their categories.

The TTX administrator creates the global "Service Not Authorized" page shown in Figure 24A. As can be seen, rows 1-7 and 13-19 have been designated as global rows. Only users who have at least EDIT rights with their scope set to ALL or GLOBAL on every filter may modify these rows. Rows 8-12 have been allocated for use by category managers. Because the television and radio service managers are invested with CREATE rights with respect to their categories, they may customize rows 8-12. For example, the television manager may create the page shown in Figure 24B. The radio manager may create the page shown in Figure 24C. Note that rows 8-12 have been allocated for television category use by the television manager and for radio category use by the radio category manager.

The addition of multiple radio services to the example of Figure 23 can be supported using the same user configuration, in which case the radio category manager would also be responsible for each radio service. Alternatively, new users may be created as illustrated in Figure 25. In Figure 25, a new user for radio service 1 and a new user for radio services 2 and 3 have been created. The radio manager has decided to grant the new radio service users EDIT rights only with respect to their radio services. Thus, the new radio service managers will only be able to modify data corresponding to their radio services. They are not able to create new radio service number specific data. With the exception of the TTX administrator, the radio manager has retained sole responsibility for allocating radio service number specific data.

The radio manager creates the "Radio Service Not Authorized" page for radio service 1 as illustrated in

Figure 26A. Rows 8-12 remain radio category pages. The radio manager allocates row 9 for user by radio service 1. Only having EDIT rights with respect to radio service 1 data, the radio service 1 user cannot modify rows 8, 10, 11, and 12. Radio service 1 user may enter data on row 9 only as shown in Figure 26B. All other rows may be viewed but not changed.

The radio manager must repeat the page creation for radio services 2 and 3. This may be accomplished by replacing the service filter value of 1 with 2 and 3, respectively. Likewise, using EDIT rights, radio service 2 and 3 user also creates the required service pages by entering the appropriate data in row 9.

Figure 27 illustrates a system similar to that of Figure 25 with the addition of a user definition supporting television time zone data. As illustrated in Figure 27, the new television time zone user has EDIT rights with respect to television time zone data and VIEW rights with respect to language, category, and service number data. Accordingly, the time zone user is responsible solely for television time zone specific pages. The television time zone user thus has the ability to modify television time zone specific data, but not create new television time zone specific data. The television manager has assumed the responsibility for allocating television time zone specific data.

The television time zone user can create the page illustrated in Figure 28 for time zone 1, for example. The television manager may create the page of Figure 28 with row 12 empty and allocated for time zone 1. The page must be recreated for each time zone with row 12 allocated for each available time zone. The television

time zone user fills in row 12 with the appropriate time zone data.

Figure 29 illustrates an user definition scheme in which closed captioning television services are supported. In this case, the responsibility for television captioning is delegated to the television manager. The television manager has been given CREATE rights to the global language and language 1. The television manager may thus create global and language 1 specific data. Accordingly, the television manager is provided with a wide range of power to support language 1 for all television data, not only for captions.

As illustrated in Figures 30A and 30B, the television manager may create two empty pages, both assigned to the television category, but one for global language and for language 1 data. For example, Figure 30A may represent an English language caption page and Figure 30B may represent a French language caption page.

With some networks, such as impulse pay-per-view (IPPV) networks, for example, it is desirable or even necessary to provide TTX system support to guide a subscriber through procedures, such as to purchase an event for IPPV. These networks may require, for example, program specific information to be entered on a TTX page. In the case of IPPV, for example, a subscriber would likely be reluctant to purchase a program unless he knew the title and cost of the program. Such information may change relatively frequently and would require a considerable investment in manpower if the pages had to be manually updated and placed on transmission.

It is possible to take advantage of circumstances in which broader classes of information remain relatively constant even though specific information changes

frequently. Again, using IPPV as an example, every IPPV program has a title and a cost, however the exact values of change program to program. Accordingly, a generic TTX page could be created with place holders where the changing data can be placed. Such pages will be referred to herein as skeleton pages, and the place holders will be referred to as templates. On a program change, new templates may be loaded and automatically modify all skeleton pages. Of course, as the above description suggests, skeleton pages are not restricted to IPPV networks.

While the following example will be described in the context of IPPV, it should be understood that any network that has relatively frequently changing data over relatively static TTX pages may take advantage of skeleton pages to automatically update pages. A skeleton page illustrated in Figure 31A. The "S%" attribute in the title row identifies the page as a skeleton page with a template delimiter "%". Of course, skeleton pages and template delimiters can be identified in other ways. All templates are named and placed in the skeleton page surrounded by "%". The placement of the "%"'s determines the size of the template. For example, the above page has the following templates: movie rating, PR; movie title, TITLE; stars of the movie, STARS; and the cost of the movie, COST. When the program is aired, the templates must be filled. Figure 31B depicts the skeleton page of Figure 31A having: PR = "G"; TITLE = It's A Wonderful Life"; STARS = "James Stewart"; and COST = "$ 2.50".

Logical filters allow for the dynamic allocation and ordering of the physical filters discussed above. In the discussion of Figures 11-31B, it was assumed that the

initial allocation of bits to each physical filter and their definitions will be sufficient to support all TTX features, present and future. In addition, the above description included implied a hierarchy for the filters. For example, filters were activated first by language, then by category, service number, time zone, etc. While some filter types may have an implied priority, other may not. For example, all things being equal, the language filter may have the highest priority or the lowest priority. However, in the context of specific systems, there may be a valid reason to allocate a language filter as the highest priority, or as the lowest priority. For example, the system operator may wish to create users responsible for maintaining a specific language. In such a case, the language filter may be set to have the highest priority. Alternatively, if pay-per-view (PPV) were important, an operator may set category to the highest priority and create users to manage the PPV movie category.

A logical filter is a grouping of physical filters. Each physical filter may be a member of only one logical filter. The logical filter is created by combining all of the physical filter values. The physical filter number determines how the physical filter values are concatenated. For example, the higher the physical filter number the higher the bit position. Accordingly, a logical filter comprised of physical filters 1 (PF1), 5 (PF5), and 7 (PF7) will have a physical filter value constructed by concatenating PF7, PF 5 and PF1, with the PF1 bits occupying the least significant bits and the PF7 bits occupying the most significant bits. The physical filter value may be padded with, for example, 0s. Of

course, the specific ordering for concatenation and the padding bits should not be considered limiting.

An existing logical filter can be extended by adding another physical filter to the group, or a new filter of any size may be created from unused physical filters by grouping them together. Furthermore, logical filters can be assigned hierarchies. A hierarchy may be created, for example, by assigning logical filter numbers to each logical filter with the lower the logical filter number, the higher the ordering. However, this should not be considered to limit the present invention.

Encryption and allocation will now be discussed. Encryption is performed at the encoder and decryption is performed at the decoder. Additional details concerning encryption may be found in U.S. Patent Application Serial No. 08/101,974, entitled "Method and Apparatus for Uniquely Encrypting A plurality of Services at a Transmission Site", filed August 4, 1993 and incorporated herein by reference. The term "allocation" refers to the assignment of page ranges within a maximum page range for particular classifications of service. Allocation may become necessary for more limited embodiments of the encoder and/or decoder. In one preferred embodiment of the present invention, the multiplexer may perform the encoding or encrypting functions and thus may be considered an encoder or encryptor. The term "encryptor" may also be used herein to refer to an item or seed used to encrypt particular text data.

Prior to discussing the specifics of allocation, encryption will be discussed briefly. In the encrypt block 415, the encoder may maintain a teletext seed table (TST) of n teletext seeds TS0, . . ., TSn, wherein n can be any whole number. For example, n may be 31 thereby

yielding 32 teletext seeds. Each teletext seed TS0, . . ., TSn in the teletext seed table represents a unique way of encryption and may be considered a physical teletext elementary stream (TES). Accordingly, the teletext seed table maps each teletext seed TS0, . . ., TSn to a corresponding TTX elementary stream TES 0, . . ., TES n. Alternatively, a table of TS's need not be stored in a table if the encryptor automatically generates TS's based on a TES. Accordingly, TES in the teletext header would indicate to the encryptor how to generate the TS's for encryption.

Each teletext seed in the teletext seed table may be generated each cryptocycle by performing a seed expansion using a 32 bit random number and a seed procreation number. The details of the seed expansion will not be discussed in herein. However, the manner in which the teletext seeds are generated is not material so long as each TS is unique. In addition, it is required that some mechanism be provided to for delivering all TS's to the decoders. Seed generation provides one method for generating unique TS's and for delivering them to the decoders.

As discussed above, the TTX system of the present invention may be configured to provide such teletext services as network control, teletext programs, teletext for non-teletext programs, broadcast or general messages, personal messages, and an electronic program guide among other possibilities. The particular filter settings, encoder requirements, decoder requirements, and page range for each of these teletext features according to two specific embodiments will be described below with reference to Figures 32A and 32B, respectively. It should be recognized that the specific embodiments

discussed below are intended to be mere examples and that other embodiments are possible.

Three filters specify a teletext page with a particular service: service category, service number, and control. The control filter may correspond to FILTER 6, FILTER 7 or FILTER 8 of the TTX header row packet. As discussed above, the service category filter can specify between one of a number of service categories such as TV, radio, text, data, etc. The service number identifies a particular service offered from a service category. Thus, service category and service number together uniquely identify a particular service. The control filter is used to identify TTX pages which are part of a TTX service per se and pages which are used to support other services.

For network control pages, the filter setting for the control filter is, e.g. "1". The category and service number filters may have any setting, i.e. "don't care" as illustrated in Figures 32A and 32B. The network control pages may occupy one of two page ranges depending on implementation for reasons discussed further below. The two page ranges are illustrated in Figures 32A and 32B. Of course, it should be clear that the maximum range of 0000-FFFF is not intended to limit the present invention for any of the TTX features. One of the teletext seeds in the teletext seed table of the encoder is allocated for network control pages. Any encrypted pages which have the control filter set must be encrypted with this teletext seed. In the simplest case, the encoder has a fixed allocation for network control pages. In other words, one particular seed of the teletext seed table will always be allocated for the network control pages. A more complicated implementation may require

dynamic allocation of TES #'s for encryption on-demand. In either case, the DISE of the decoder generates the network control seed every cryptocycle.

Broadcast or general messages (also referred to as broadcast pages) have the same security concerns and can be handled in the same manner as the network control pages. The nature of the broadcast requires that all broadcast pages have all filters except the control filter disabled so that all decoders will receive the page. The control filter will be enabled and set to, e.g., "1" to indicate a network control page.

For teletext programs, the category filter may be set to any one of the available teletext categories, e.g., TTX1, TTX2, ..., TTXm, where m is the number of different teletext categories. TTXi of Figures 32A and 32B is a category as a TTX type category. The service number filter may be set to n, which may be any available service number for a particular category. The control filter is enabled and set to, e.g. "0", to indicate the absence of a network control page. The page range for teletext programs is illustrated in Figures 32A and 32B. The encoder must allocate (either fixed or dynamic) one teletext seed table entry for every TTX service in order to ensure that each TTX service is encrypted differently. A mapping of this allocation, i.e., TES # to filter values used to identify a particular service (just for each service category and service number) is maintained in the encoder. The encoder transmits information concerning how to generate the seed to the DISE 157 by placing the TES # into the PACKETS data, for example, in the virtual channel packet.

Once encryption is enabled, all TTX service pages will have their service category and service number

filters enabled. Disabling a filter may cause rows to be shared between pages. Encryption of these rows may cause conflicts with specific annotation rows which are encrypted with a different seed. For example, a single page may include annotation rows that are specific to different services and that are encrypted differently as well as one or more common rows. If the service category and service number filters were disabled, the decoder would erroneously use both annotation rows to construct the page. Because the decryptor is loaded with the teletext seed for the page to be grabbed, the common rows may be transmitted without encryption to prevent any problems decrypting the page at different decoders. Alternatively, multiple decryptors may be provided for decrypting multiple rows encrypted differently.

Teletext support for non-teletext services may be implemented exactly as a TTX service. The category filter may be set to any non-TTX category, e.g., television, radio, etc. The service number filter may be set to n, which is any available service number for the selected category. As above, the control filter is set to, e.g. "0", to indicate the absence of a network control page. Each of the filter values and the page range is illustrated in Figures 32A and 32B.

Since encryption for non-TTX services is supported in the same way as TTX services, the encoder has the same requirements as for TTX services. The only difference between the two may be the method of allocating teletext seed table entries to the services. For example, TTX services may have a fixed allocation, thereby ensuring that a TES will always be available, and non-TTX services may be allocated dynamically on a first come first served basis. Thus, once all of the TES's are allocated, a non-

TTX service cannot be encrypted. Of course, non-TTX services may have a fixed allocation and non-TTX services may be allocated dynamically. Both TTX and non-TTX services having TTX support appear identical to the decoder. Therefore, the decoder must handle the TTX support of non-TTX services in the same manner as TTX services.

Personal messages (PMs) may be considered a text service. PMs are typically initiated at the encoder for transmission to a subset of decoders. PMs may be encrypted addressed data packets (ADPs) which deliver the TES #, page number and a time stamp indicating when the release of the PM teletext seed is to terminate. The ADP is a particular kind of PACKETS data packet that may be received only by individual decoders. Group PMs may be implemented by individually addressing each decoder in the group.

Depending on security concerns, all PMs may be encrypted the same way. Thus, the PMs would be secure from all those who do not receive them. However, it is conceivable that a PM may be received by a subscriber (who was sent a different PM) other than to whom the it was addressed. Alternatively, PMs may be classified in groups having different encryptors. Each of the groups may be considered a different service because each has its own encryptor.

Handled as a TTX service, the PMs may have a category filter setting of TTX and a service number filter setting of n, where n is any PM TTX service number. The control filter may be set, e.g., to "0", to indicate the absence of network control data. The filter values and page range for PMs is illustrated in Figures 32A and 32B. The transmission of PM pages and ADPs must

be tightly coupled in time because the ADP triggers the page grab. If either the PM or the ADP is absent, the page is not received. The PM ADP has a limited life span and the encoder must ensure that the PM page is transmitted with sufficient frequency within this life span. The DISE must release the PM teletext seed for a limited number of cryptocycles after it receives the PM ADP.

The electronic program guide (EPG) may be offered as a standard feature or as a revenue generating TTX service. If offered as a standard feature, the EPG pages may be treated as network control pages. For example, the standard electronic program guide could be accessed as a selection from a main menu. Accordingly, the electronic program guide would occupy a portion of the network control page range as illustrated in Figure 32A since these pages would be indistinguishable from other network control pages.

Alternatively, the EPG may be offered as a TTX service, where the EPG pages may be treated as a unique TTX service. TTX service electronic program guide requires that the decoder tune to the TTX service. A virtual channel will be available to support the electronic program guide and a full range of EPG pages is possible as illustrated in Figure 32B. The filter settings for TTX service electronic program guide are identical to TTX service filter settings, namely the category filter is set to TTX, the service number filter is set to n, and the control filter is set, e.g. "0", to indicate the absence of network control pages.

The encoder maintains TTX encryption by mapping services to teletext seed table entries. In one implementation, there is one fixed allocation for the

network control pages and the rest are dynamically allocated for use by the electronic program guide, personal messages, and service pages, both TTX and TTX support for non-TTX services. In a more flexible implementation, all pages may be dynamically allocated.

The allocation example depicted in Figure 33 allows for easy calculation of teletext seed table entries. The network control pages will have a reserved TES # of 31. The personal messages will have a reserved TES # of 30. This limits the personal messages to one physical text stream, i.e. only one class of encryption for all personal messages. However, the TES # may still be transmitted in the ADP to allow for future reallocation. In the simplest case only one type of TTX category exists. By reserving TTX service TES #s starting at 0, the TES # can be made to correspond with the TTX service number. Only non-TTX service numbers would not have a simple correlation with TES #s. The encoder will dynamically allocate TES #s to non-TTX services.

The allocation scheme described above is particularly useful when the multiple page grabbing logic is similar to that depicted in Figure 7, where each page grabber has its own decryptor and aggregate filter comparator. However, multiple page grabbing logic similar to that depicted in Figure 8 limits the available allocation of page ranges for particular services. As in Figure 8, each page grabber shares a decryptor (the seed limitation) and aggregate filter comparator (the filter limitation). As a result, each page grabber will use the same filter values and decryption seeds with only the page number unique to each grab.

One consequence of the filter limitation is that the decoder is forced to perform only one TTX function at any

time, i.e., grabbing network control pages, or viewing a TTX service, or receiving a personal message, etc. However, it is desirable to receive personal messages in the background even if the decoder is viewing other TTX pages. Therefore, in order to implement a system that meets subscriber and operator expectations, the TTX functions that may occur simultaneously must be identified. Further, each of these TTX functions must generate matches for the same aggregate filter comparator. Since only the page number may be used to identify these TTX functions uniquely, the simultaneous TTX functions must exist together in the page address space. If, for example, broadcast pages, network control pages, service related pages, and personal messages each must be capable of being received simultaneously, the decoder must simultaneously grab broadcast pages, network control or service related pages, and personal message pages. If broadcast pages are lumped together with network control pages, the simultaneous grabs could be expanded to network control pages including broadcast pages, service related pages (i.e., TTX service pages and TTX support for Non-TTX services), and personal message pages.

In the example of Figures 32A and 32B, network control pages were identified by the control filter. Under the filter limitation, setting the filters to grab a network control page prevents service related and personal message pages from being grabbed since they have their unique control bits cleared. Thus, the control filter may no longer be used since it is unique for network control pages. Network control pages must be distinguished from service related and personal messages using the page number filter. The result is that the

network control pages may no longer occupy the full page range of 0000-FFFF. Rather, this page range must be divided among the various TTX features.

Service related and personal message pages use the category and service number filters to identify themselves. The service related and network control pages grabbed will depend on the particular service that the decoder is tuned to. The decoder retrieves filter information from the virtual channel selected by the subscriber for viewing. However, setting the filters according to the virtual channel prevents personal messages from being received since they have their own unique category (TTX) and service number which may be different from the channel selected by the subscriber. As with the network control pages, a portion of the full page range must be allocated for personal messages. The personal messages may no longer enable the category and service number filters. Both must be disabled to allow any decoder to receive them no matter which virtual channel is being viewed. The new page ranges for the features are illustrate in Figure 34.

Despite the limitation in page range, other defined filters may still be enabled. Thus, several pages having the same page number may be distinguished using these filters. The operator may ensure that the subscriber receives certain messages by disabling these filters.

The encryption of the pages described above does not change. The determination of which page belongs to which service also does not change. In some implementations, the encoder can determine the usage of a page based on its service category and service number filters. In other implementations, the page number must also be used to identify the TES for encryption.

The seed limitation prevents the decoder from grabbing multiple pages that are encrypted with a different teletext seed. All services cannot be encrypted with the same teletext seed for security reasons. The TTX decryptor may be modified to allow for multiple teletext seeds. Ideally there should be exactly as many teletext seeds as there are simultaneous TTX functions, for example, three in the case discussed above. It may be acceptable to specify that a broadcast page may not be encrypted, since the broadcast is received by all encoders. If this is the case, then only two seeds need to be supported.

While the present invention has been disclosed with respect to a preferred embodiment and modifications thereto, it is to be understood that the invention is not limited to the precise embodiments and that various changes and modifications may be effected therein by those in the art without departing from the scope and spirit of the invention.

We Claim:

1. In a receiver of a communication system for receiving digital data streams of a plurality of services multiplexed in a sequence of frames, wherein a frame of said sequence of frames includes a teletext header packet defining at least a portion of a teletext page and having a plurality of filter fields, each filter field having a filter value, an apparatus for generating a teletext page comprising:

extracting means for extracting the teletext header packet from the frame;

comparing means for comparing the filter value for each filter field of the extracted teletext header packet to a corresponding requested filter value and for generating a matching signal if each filter value matches the corresponding requested filter value; and

constructing means, responsive to the matching signal, for constructing the portion of the teletext page defined by the extracted teletext header packet.

2. The apparatus of claim 1, wherein the sequence of frames additionally includes at least one teletext data packet corresponding to each teletext header packet, and wherein:

said extracting means further extracts a teletext data packet corresponding to the extracted teletext header packet; and

said constructing means further constructs the portion of the teletext page defined by the teletext header packet using the teletext data packet.

3. The apparatus of claim 1, wherein said teletext header packet includes a page number filter field having a page number value, and wherein said comparing means comprises:

a page comparator for comparing the page number value to a requested page number value.

4. The apparatus of claim 1, wherein said comparing means comprises:

an aggregate filter comparator for comparing filter values from the filter fields to corresponding requested filter values.

5. The apparatus of claim 1, wherein said teletext header packet includes a page number filter field having a page number value and a plurality of aggregate filter fields each having a filter value, and wherein said comparing means comprises:

a page comparator for comparing the page number value to a requested page number value; and

an aggregate filter comparator for comparing the filter values of the aggregate filter fields to corresponding requested filter values.

6. The apparatus of claim 5, wherein the aggregate filter field comprises a language filter field having a language value, and wherein said aggregate filter comparator comprises a filter comparator for comparing the language value to a requested language value.

7. The apparatus of claim 5, wherein the aggregate filter field comprises a category filter field having a category value, and wherein said aggregate filter comparator comprises a filter comparator for comparing the category value to a requested category value.

8. The apparatus of claim 5, wherein the aggregate filter field comprises a service number filter field having a service number value, and wherein said aggregate filter comparator comprises a filter comparator for comparing the service number value to a requested service number value.

9. The apparatus of claim 5, wherein the aggregate filter field comprises a time zone filter field having a time zone value, and wherein said aggregate filter comparator comprises a filter comparator for comparing the time zone value to a requested time zone value.

10. The apparatus of claim 5, wherein the aggregate filter field comprises a security element filter field having a security element value, and wherein said aggregate filter comparator comprises a filter comparator for comparing the security element value to a requested security element value.

11. The apparatus of claim 5, wherein the teletext header packet further includes a filter enable value corresponding to each of the aggregate filter fields, each filter enable value having either a first value or a second value, wherein said aggregate filter determines for each aggregate filter field a match if (1) its filter value matches the corresponding requested filter value and the corresponding filter enable value has a first value or (2) the corresponding filter enable value has a second value.

12. In a receiver of a communication system for receiving digital data streams of a plurality of services multiplexed in a sequence of frames, wherein a frame of said sequence of frames includes a teletext header packet defining at least a portion of a teletext page and at least one teletext data packet associated with the teletext header packet, the teletext header packet having a page number filter field having a page number value and aggregate filter fields having aggregate filter values, an apparatus for generating a teletext page comprising:

extracting means for extracting the teletext header packet from the frame;

page comparators, each comparing the page number filter value of the extracted teletext header packet to a respective requested page number value and for outputting a matching signal if the page number filter value matches the respective requested page number value;

at least one aggregate filter comparator for comparing the aggregate filter values of the extracted teletext header packet to requested aggregate filter values and for outputting a matching signal if the aggregate filter values match the requested aggregate filter values;

page grab logic circuits, each responsive to the matching signal from one of said page comparators and the matching signal from the at least one aggregate filter, for outputting page construction information according to the at least one teletext data packet and to the teletext header packet; and

page construction memory associated with each page grab logic circuit for receiving the page construction information thereby forming the portion of the teletext page defined by the teletext header packet.

13. The apparatus of claim 12, wherein the at least one teletext data packet is encrypted, and further comprising:

at least one decryptor for decrypting the encrypted teletext data packet and for supplying the decrypted teletext data packet to said page grab logic circuits.

14. The apparatus of claim 12, further comprising:

a plurality of aggregate filter comparators, each comparing the aggregate filter values of the extracted teletext header packet to respective requested

aggregate filter values and for outputting a matching signal to one of said page grab logic circuits if the aggregate filter value match the respective requested aggregate filter values.

15. The apparatus of claim 14, wherein the at least one teletext data packet is encrypted, and further comprising:

a plurality of decryptors, each decryptor decrypting the encrypted teletext data packet and for supplying the decrypted teletext data packet to one of said page grab logic circuits.

16. A method for constructing at least a portion of a teletext page defined by a teletext header packet in a data frame, the data frame comprising a multiplex of digital data streams corresponding to a plurality of services, the teletext header packet includes a plurality of filter fields, each filter field having a filter value, said method comprising the steps of:

extracting the teletext header packet from the frame;

comparing the filter values for each filter field of the extracted teletext header packet to corresponding requested filter values;

generating a matching signal if each filter value matches the corresponding requested filter value; and

constructing the portion of the teletext page defined by the extracted teletext header if the matching signal is generated.

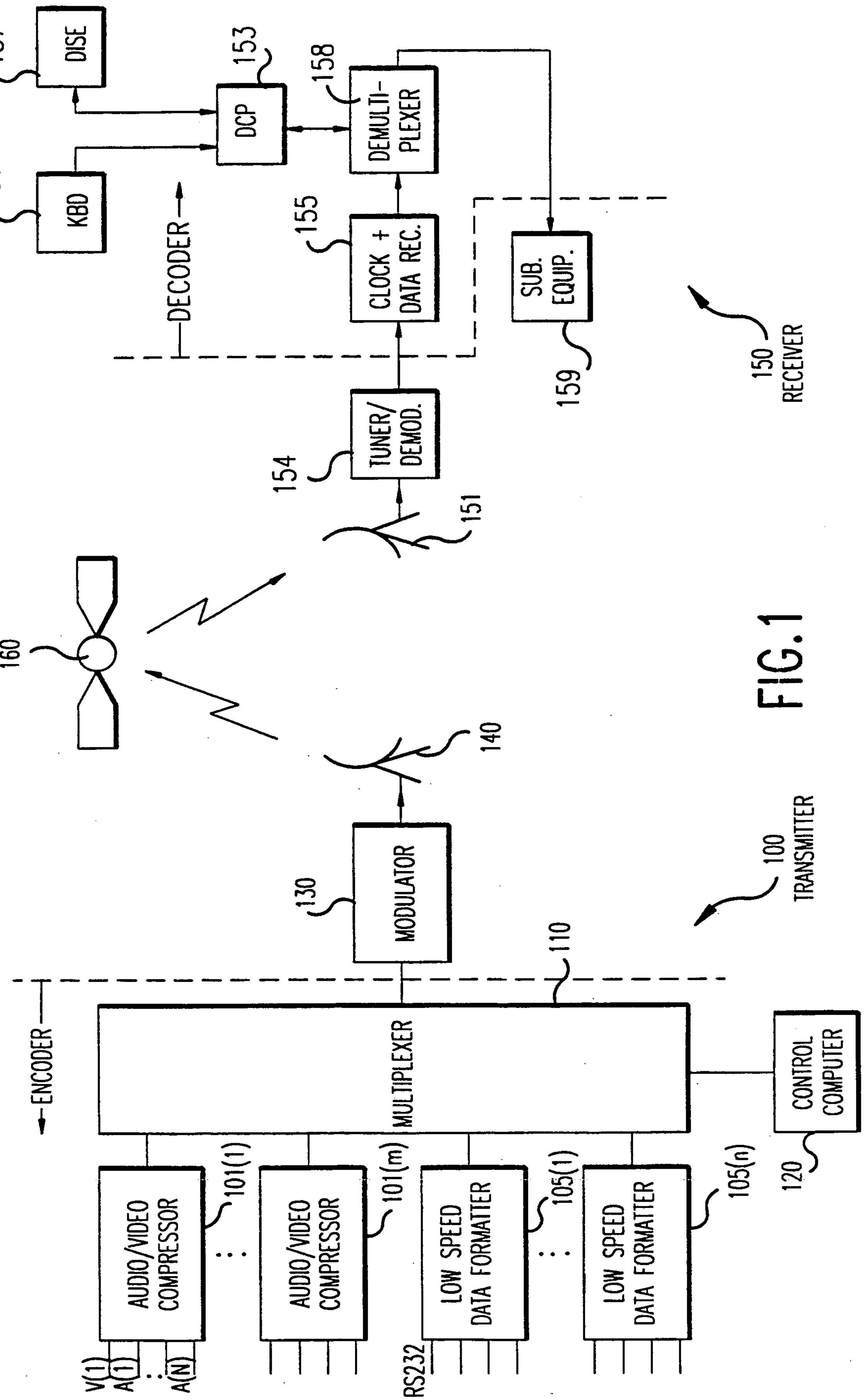

V(1)
A(1)
A(N)
AUDIO/VIDEO COMPRESSOR
101(1)
AUDIO/VIDEO COMPRESSOR
101(m)
RS232
LOW SPEED DATA FORMATTER
105(1)
LOW SPEED DATA FORMATTER
105(n)
ENCODER
MULTIPLEXER
110
CONTROL COMPUTER
120
MODULATOR
130
100 TRANSMITTER
140
160
151
TUNER/ DEMOD.
154
CLOCK + DATA REC.
155
DECODER
KBD
156
DCP
153
DISE
157
DEMULTI- PLEXER
158
SUB. EQUIP.
159
150 RECEIVER

FIG. 1

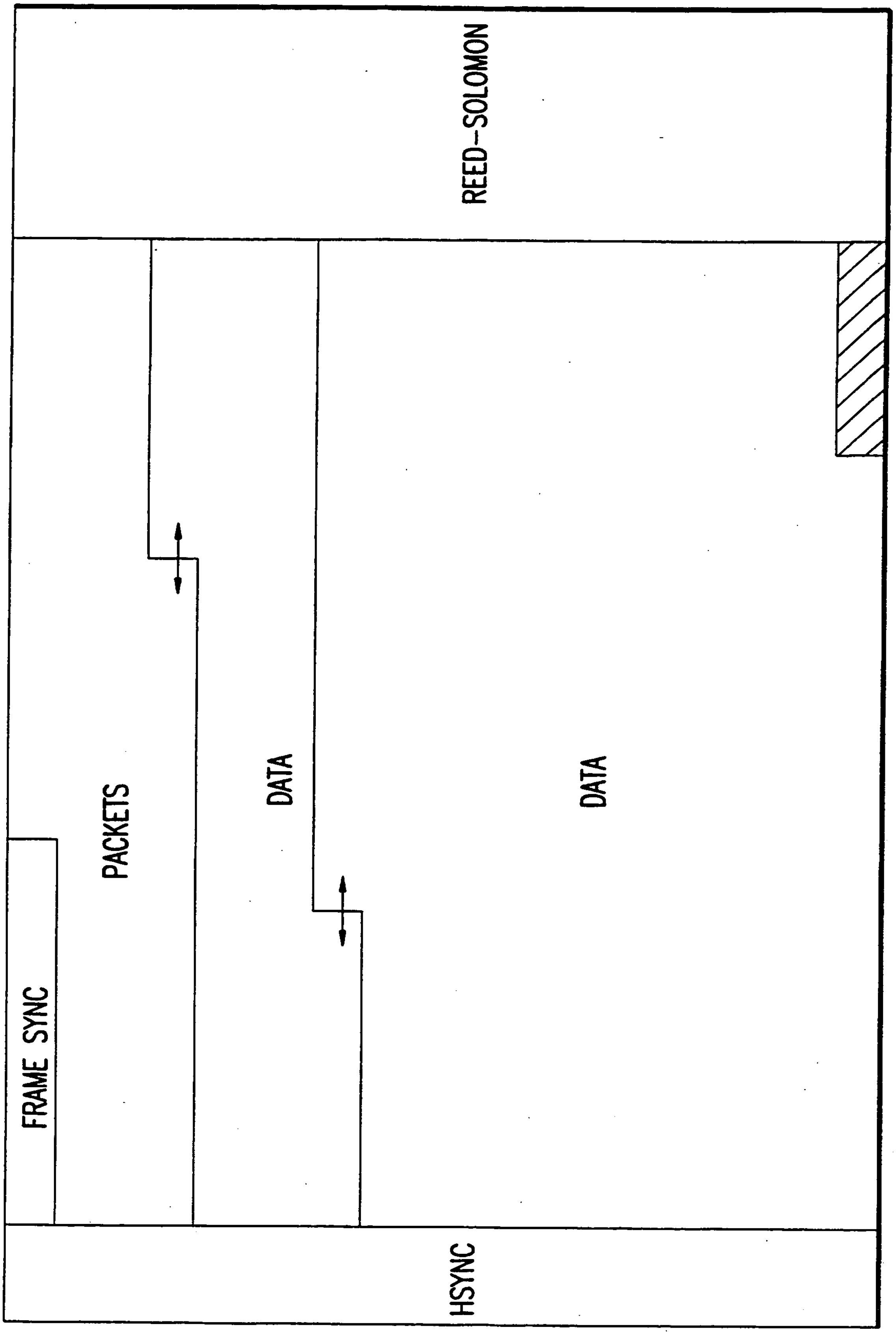


FIG.2a

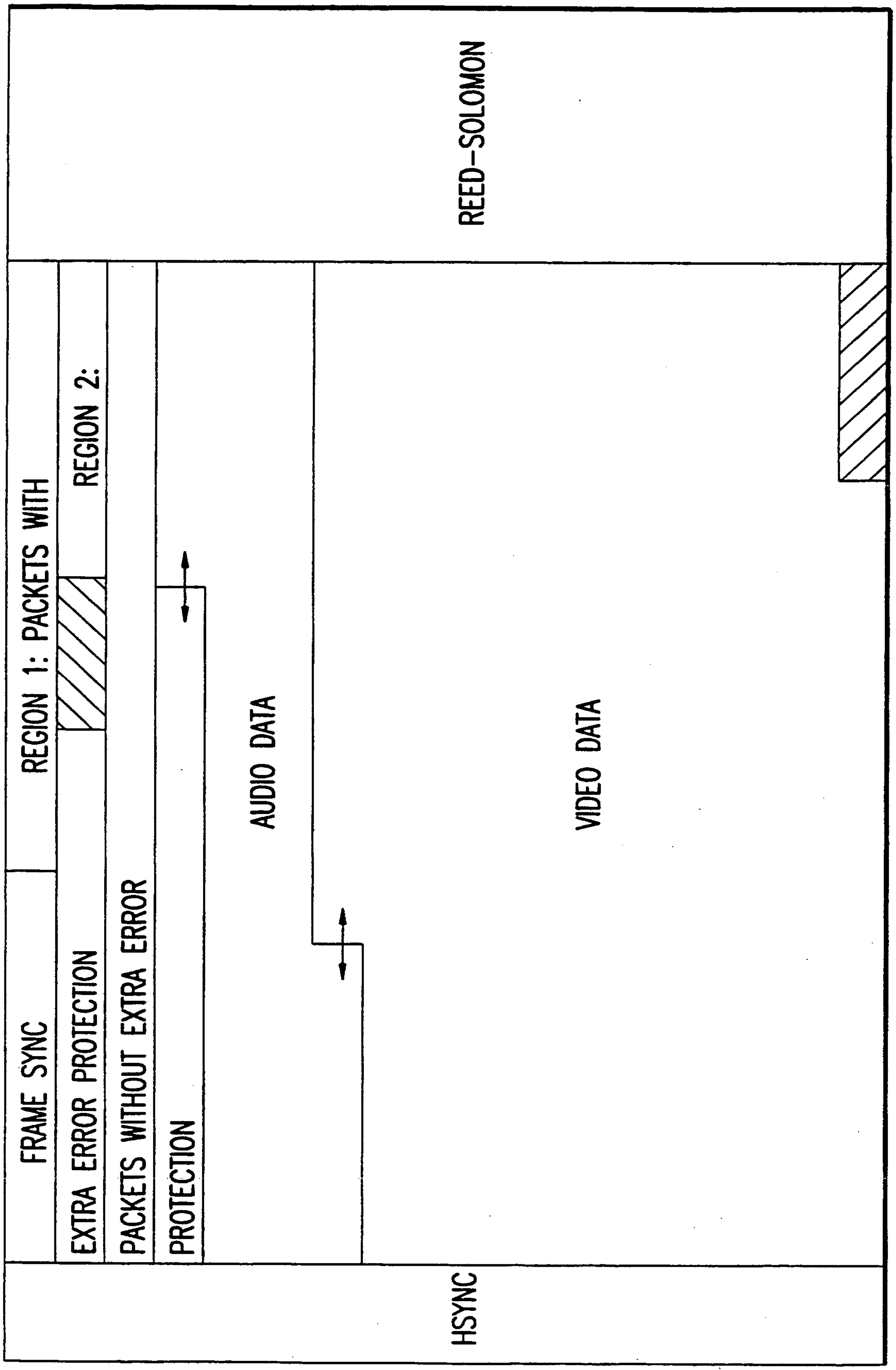

HSYNC
FRAME SYNC
REGION 1: PACKETS WITH
EXTRA ERROR PROTECTION
REGION 2:
PACKETS WITHOUT EXTRA ERROR
PROTECTION
AUDIO DATA
VIDEO DATA
REED-SOLOMON

FIG.2b

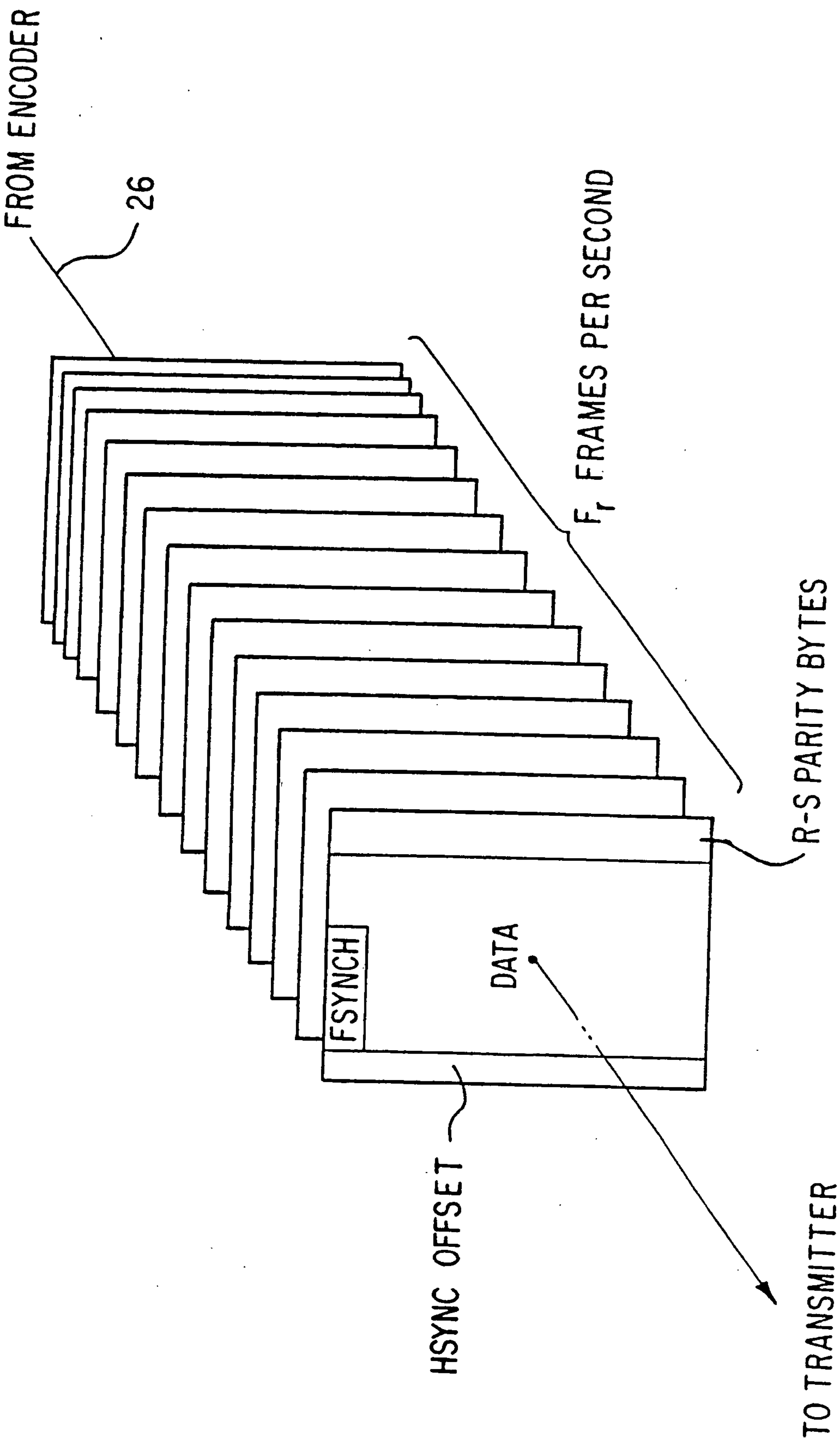

FROM ENCODER
26
F_r FRAMES PER SECOND
R-S PARITY BYTES
FSYNCH
DATA
HSYNC OFFSET
TO TRANSMITTER

FIG. 2c

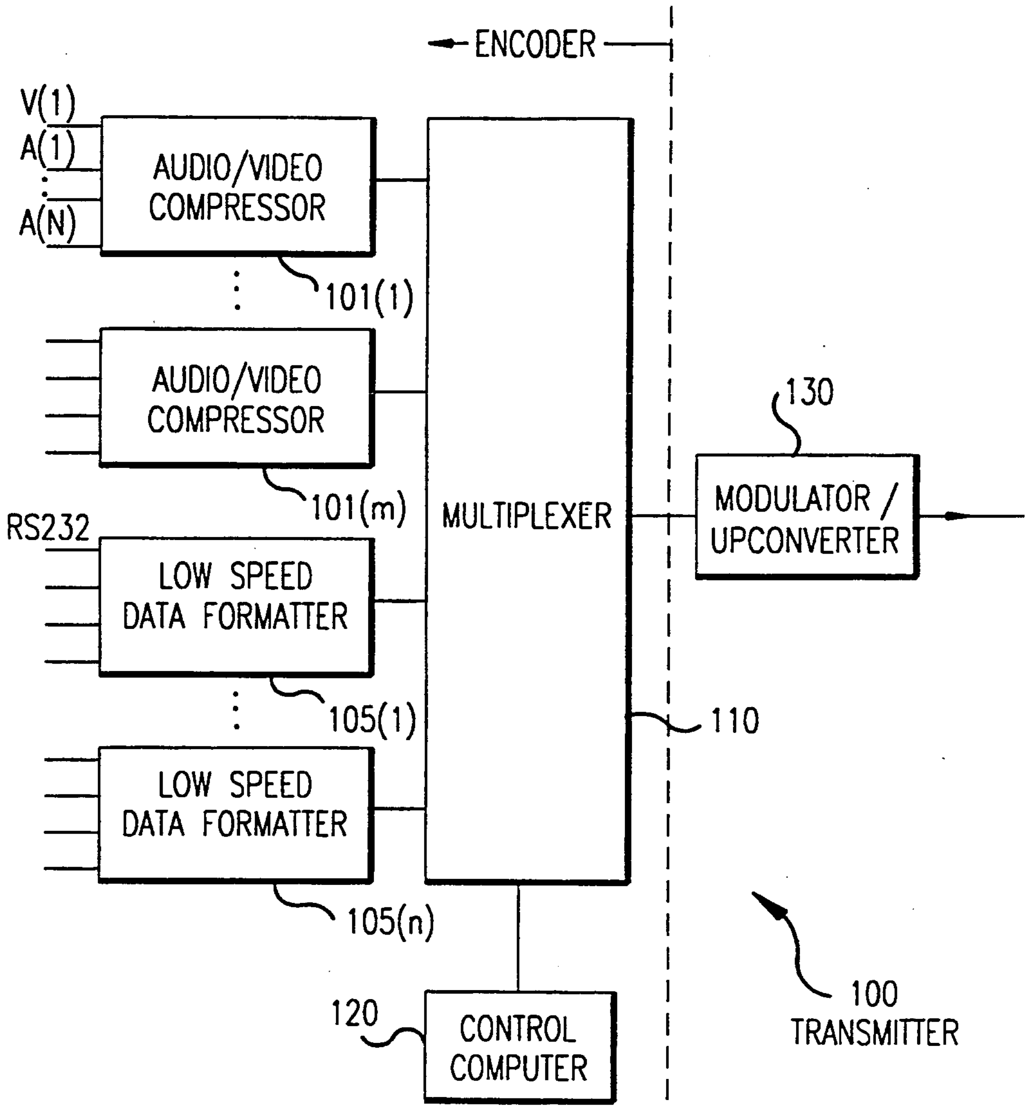

ENCODER
V(1)
A(1)
A(N)
AUDIO/VIDEO COMPRESSOR
101(1)
AUDIO/VIDEO COMPRESSOR
101(m)
RS232
LOW SPEED DATA FORMATTER
105(1)
LOW SPEED DATA FORMATTER
105(n)
MULTIPLEXER
110
130
MODULATOR / UPCONVERTER
120
CONTROL COMPUTER
100
TRANSMITTER

FIG.3

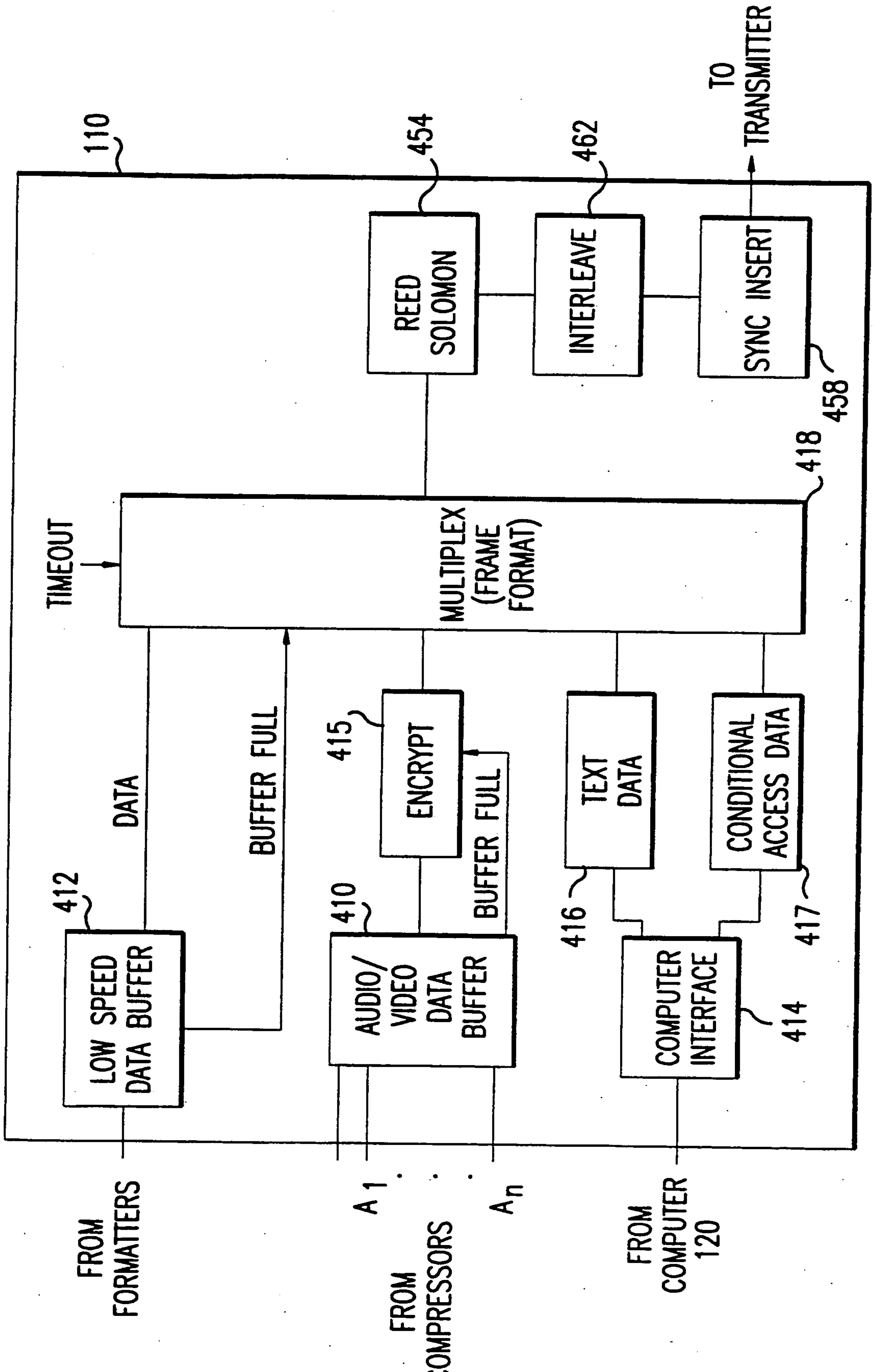

110
REED SOLOMON
454
INTERLEAVE
462
SYNC INSERT
458
TO TRANSMITTER
TIMEOUT
MULTIPLEX (FRAME FORMAT)
418
DATA
BUFFER FULL
ENCRYPT
415
BUFFER FULL
TEXT DATA
416
CONDITIONAL ACCESS DATA
417
LOW SPEED DATA BUFFER
412
AUDIO/ VIDEO DATA BUFFER
410
COMPUTER INTERFACE
414
FROM FORMATTERS
A1
An
FROM COMPRESSORS
FROM COMPUTER 120

FIG.4

FIELD DESCRIPTION	SIZE (BITS)
PACKET TYPE	4
DECODER TYPE	4
ENCRYPT FLAG	1
FORWARD LINK FLAG	1
BACKWARD LINK FLAG	1
START ROW	5
START FLAG	1
BOX MODE	2
CHARACTER SET	5
PAGE NUMBER	16
FILTER ENABLE	8
FILTER 1 (SERVICE NUMBER)	8
FILTER 2 (TIME ZONE)	3
FILTER 3 (SERVICE CATEGORY)	5
FILTER 4 (LANGUAGE)	4
FILTER 5 (SECURITY ELEMENT)	1
FILTER 6	1
FILTER 7	1
FILTER 8	1
TEXT ELEMENTAL STREAM NUMBER	8
SPARE = 0	256
TOTAL	336

FIG.5

FIELD DESCRIPTION	SIZE (BITS)
PACKET TYPE	4
DECODER TYPE	4
TELETEXT DATA	320
SPARE = 0	8
TOTAL	336

FIG.6

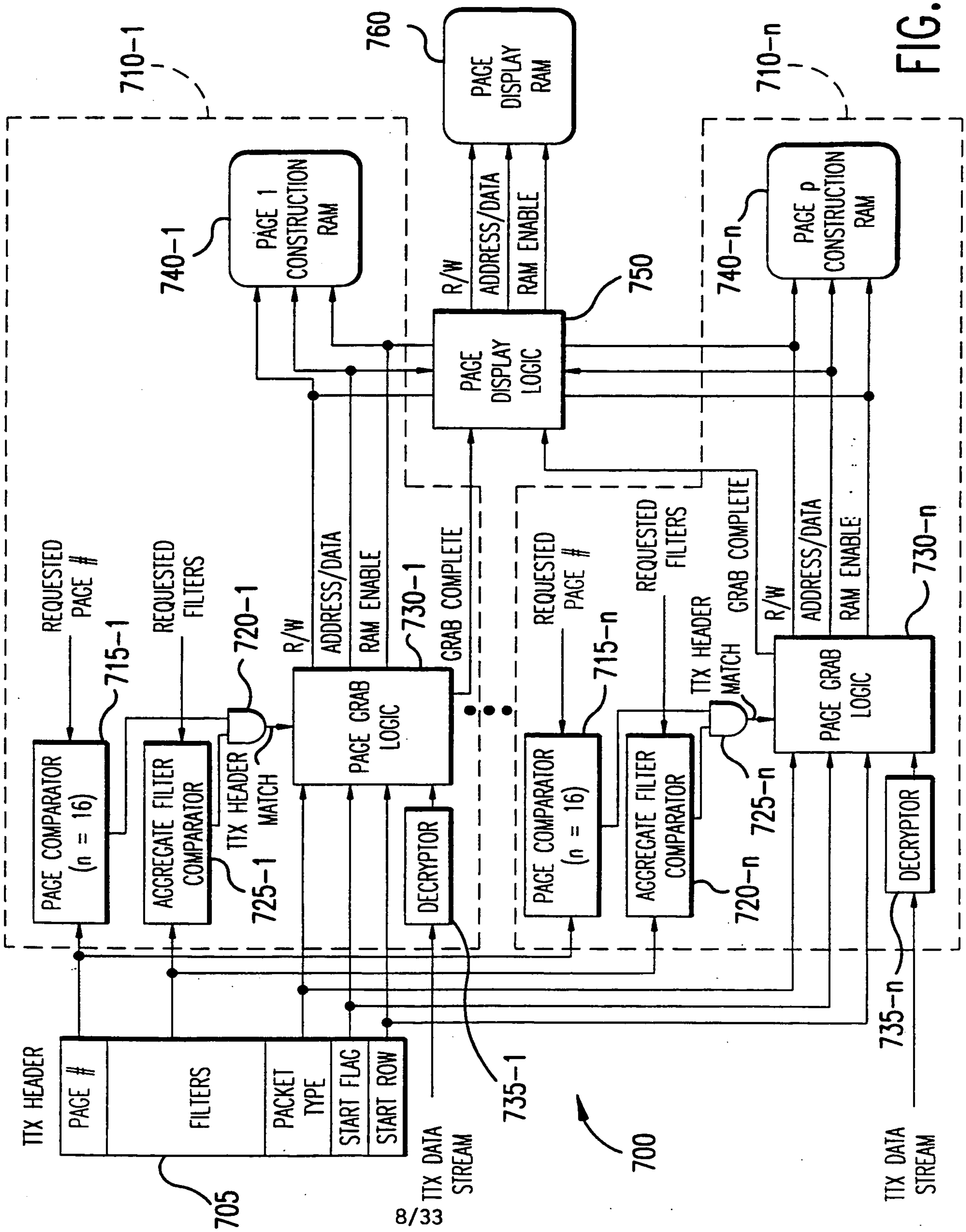

710-1
760
PAGE DISPLAY RAM
710-n
740-1
PAGE 1 CONSTRUCTION RAM
R/W
ADDRESS/DATA
RAM ENABLE
750
740-n
PAGE p CONSTRUCTION RAM
PAGE DISPLAY LOGIC
REQUESTED PAGE #
REQUESTED FILTERS
720-1
R/W
ADDRESS/DATA
RAM ENABLE
730-1
GRAB COMPLETE
REQUESTED PAGE #
REQUESTED FILTERS
GRAB COMPLETE
R/W
ADDRESS/DATA
RAM ENABLE
730-n
715-1
715-n
TTX HEADER MATCH
PAGE COMPARATOR (n = 16)
AGGREGATE FILTER COMPARATOR
TTX HEADER MATCH
PAGE GRAB LOGIC
PAGE COMPARATOR (n = 16)
AGGREGATE FILTER COMPARATOR
PAGE GRAB LOGIC
725-1
DECRYPTOR
725-n
720-n
DECRYPTOR
TTX HEADER
PAGE #
FILTERS
PACKET TYPE
START FLAG
START ROW
TTX DATA STREAM
735-1
700
735-n
TTX DATA STREAM
705

FIG.7

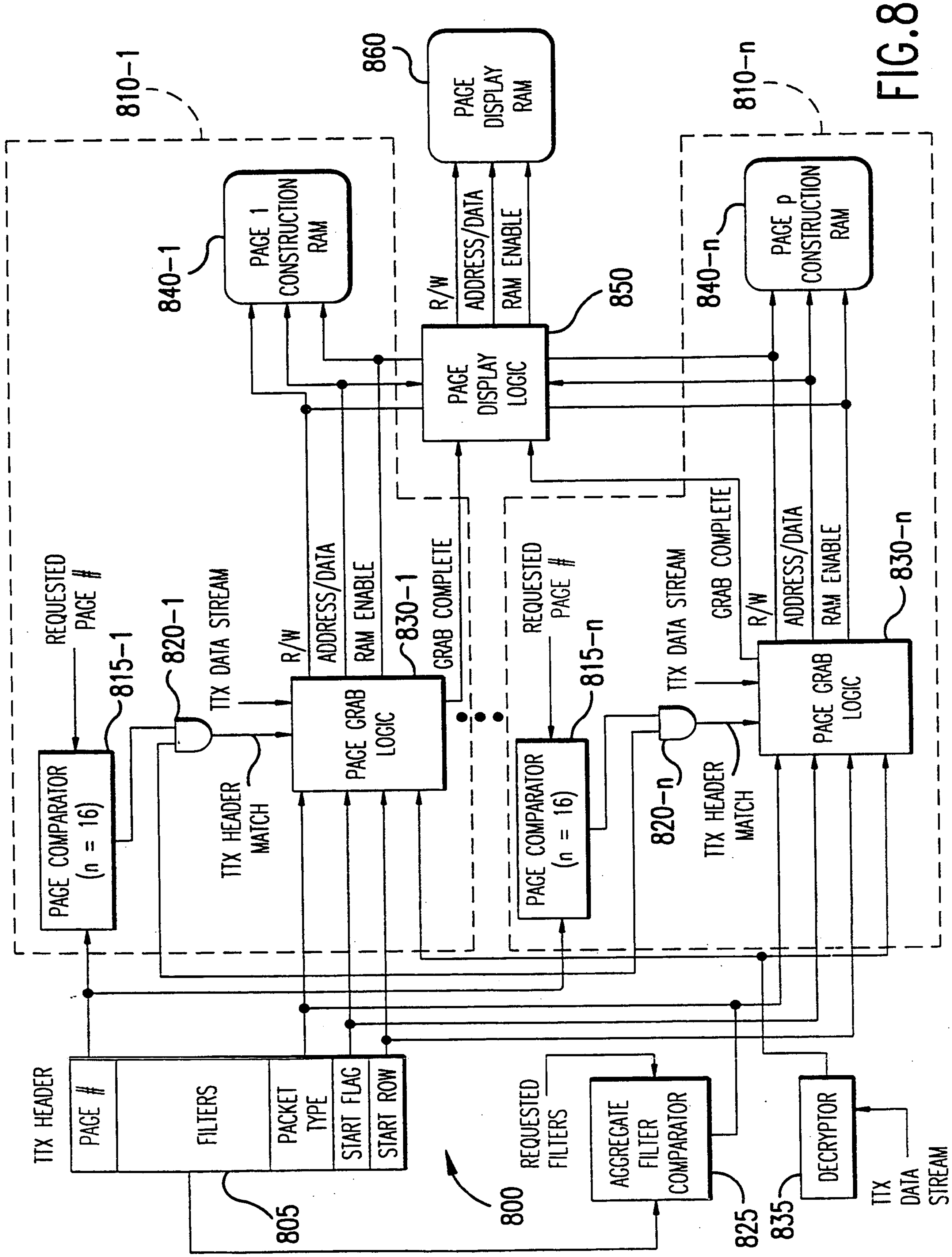

810-1
860
PAGE DISPLAY RAM
810-n
PAGE 1 CONSTRUCTION RAM
840-1
R/W
ADDRESS/DATA
RAM ENABLE
850
PAGE p CONSTRUCTION RAM
840-n
PAGE DISPLAY LOGIC
REQUESTED PAGE #
815-1
820-1
TTX DATA STREAM
R/W
ADDRESS/DATA
RAM ENABLE
830-1
GRAB COMPLETE
PAGE COMPARATOR (n = 16)
TTX HEADER MATCH
PAGE GRAB LOGIC
REQUESTED PAGE #
815-n
TTX DATA STREAM
GRAB COMPLETE
R/W
ADDRESS/DATA
RAM ENABLE
830-n
PAGE COMPARATOR (n = 16)
820-n
TTX HEADER MATCH
PAGE GRAB LOGIC
TTX HEADER
PAGE #
FILTERS
PACKET TYPE
START FLAG
START ROW
805
800
REQUESTED FILTERS
AGGREGATE FILTER COMPARATOR
825
DECRYPTOR
835
TTX DATA STREAM

FIG.8

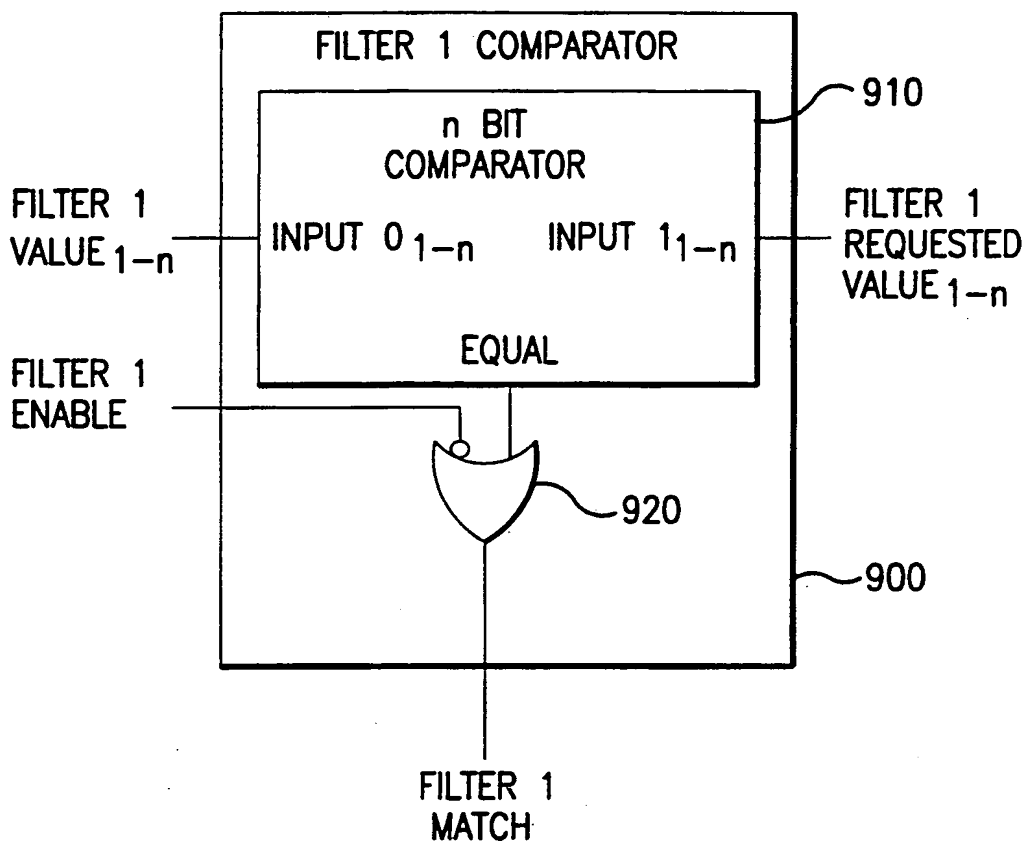
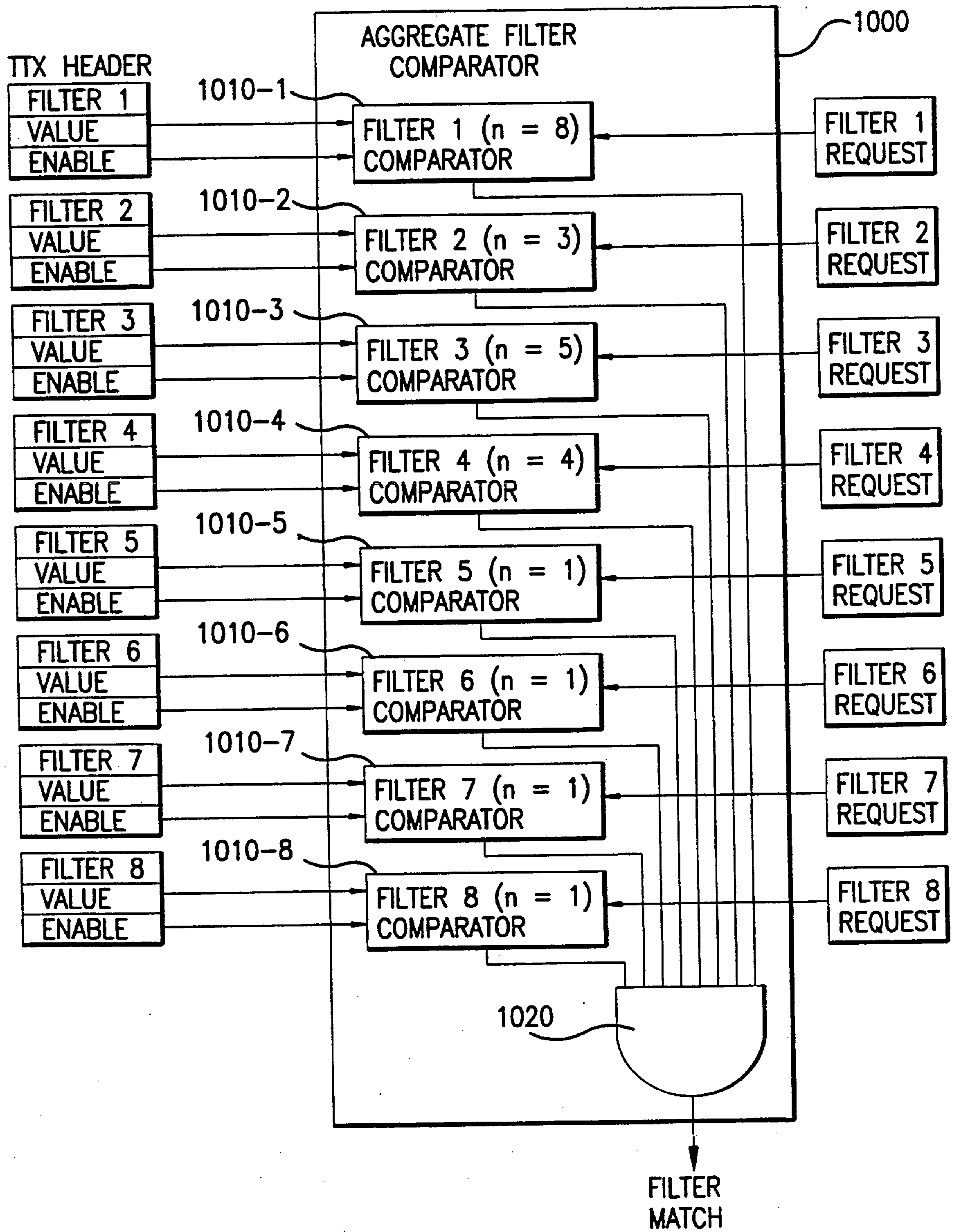

FILTER 1 COMPARATOR
n BIT
COMPARATOR
FILTER 1
VALUE 1-n
INPUT 0 1-n
INPUT 1 1-n
FILTER 1
REQUESTED
VALUE 1-n
EQUAL
FILTER 1
ENABLE
910
920
900
FILTER 1
MATCH

FIG.9



1000
AGGREGATE FILTER COMPARATOR
TTX HEADER
FILTER 1 VALUE ENABLE
FILTER 2 VALUE ENABLE
FILTER 3 VALUE ENABLE
FILTER 4 VALUE ENABLE
FILTER 5 VALUE ENABLE
FILTER 6 VALUE ENABLE
FILTER 7 VALUE ENABLE
FILTER 8 VALUE ENABLE
1010-1
FILTER 1 (n = 8) COMPARATOR
1010-2
FILTER 2 (n = 3) COMPARATOR
1010-3
FILTER 3 (n = 5) COMPARATOR
1010-4
FILTER 4 (n = 4) COMPARATOR
1010-5
FILTER 5 (n = 1) COMPARATOR
1010-6
FILTER 6 (n = 1) COMPARATOR
1010-7
FILTER 7 (n = 1) COMPARATOR
1010-8
FILTER 8 (n = 1) COMPARATOR
FILTER 1 REQUEST
FILTER 2 REQUEST
FILTER 3 REQUEST
FILTER 4 REQUEST
FILTER 5 REQUEST
FILTER 6 REQUEST
FILTER 7 REQUEST
FILTER 8 REQUEST
1020
FILTER MATCH

FIG.10

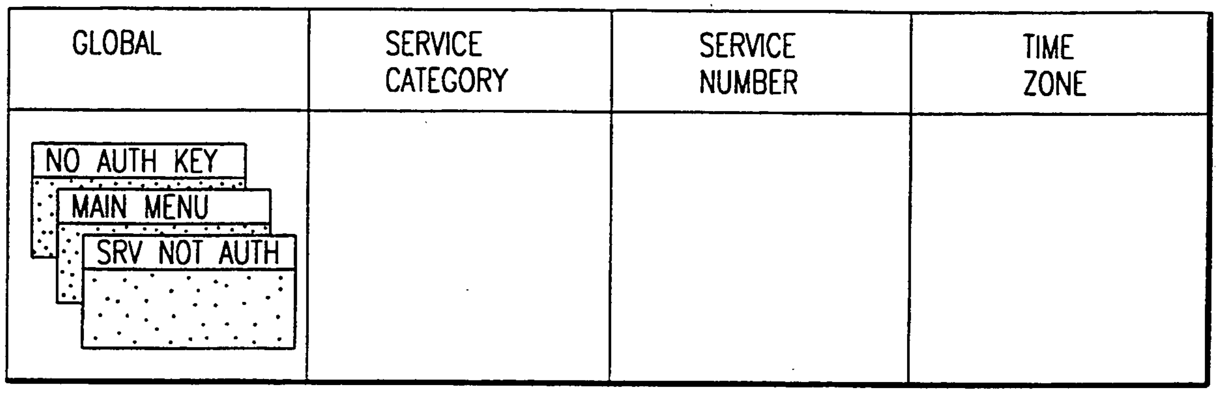

GLOBAL
SERVICE CATEGORY
SERVICE NUMBER
TIME ZONE
NO AUTH KEY
MAIN MENU
SRV NOT AUTH

FIG.11

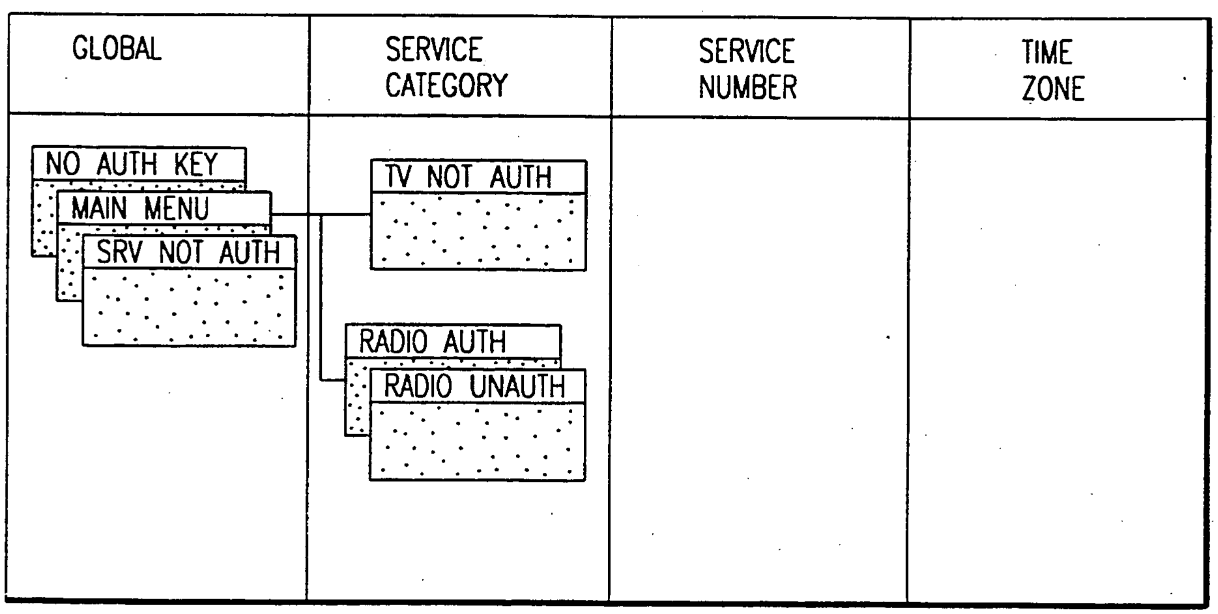

GLOBAL
SERVICE CATEGORY
SERVICE NUMBER
TIME ZONE
NO AUTH KEY
MAIN MENU
SRV NOT AUTH
TV NOT AUTH
RADIO AUTH
RADIO UNAUTH

FIG.12

PROT	ROW	RADIO SPECIFIC "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	EASY-LISTENING RADIO
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	

FIG.13A

PROT	ROW	TV SPECIFIC "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	THE PRIME-TIME MOVIE CHANNEL
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	

FIG.13B

	HEADER ROW			DATA ROW
PAGE TYPE	START ROW	START FLAG	SrvCat FILTER	TEXT
GLOBAL	7	1	---	"YOU ARE NOT AUTHORIZED FOR"
TV	9	0	TV	"THE PRIME_TIME MOVIE CHANNEL"
RADIO	9	0	RADIO	"EASY-LISTENING RADIO"

FIG.14

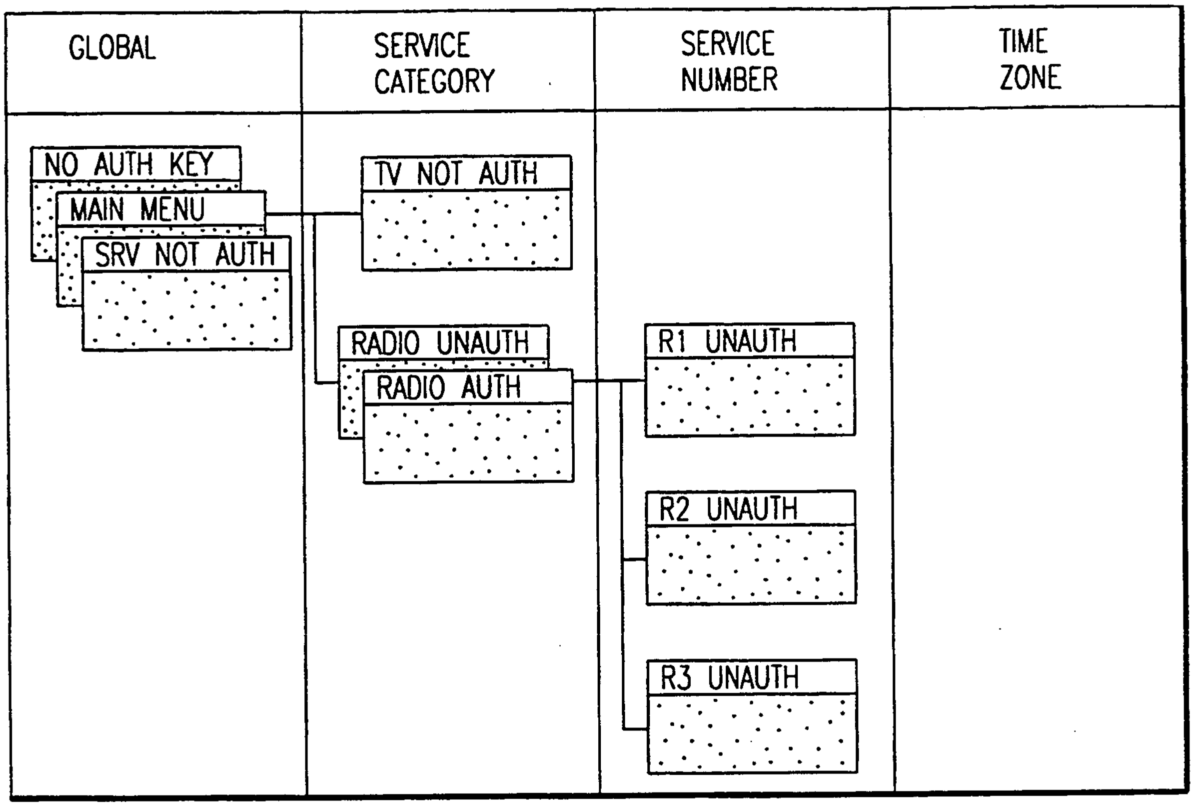


FIG.15

PROT	ROW	RADIO 1 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
SVR#	9	YOU ARE NOT AUTHORIZED FOR
	10	EASY-LISTENING
CAT	11	RADIO SERVICE
	12	
	13	
	14	
	15	
	16	
	17	
	18	

FIG.16A

PROT	ROW	RADIO 2 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
SVR#	9	YOU ARE NOT AUTHORIZED FOR
	10	HARD-ROCK
CAT	11	RADIO SERVICE
	12	
	13	
	14	
	15	
	16	
	17	
	18	

FIG. 16B

PROT	ROW	RADIO 3 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
SVR#	9	YOU ARE NOT AUTHORIZED FOR
	10	CLASSICAL
CAT	11	RADIO SERVICE
	12	
	13	
	14	
	15	
	16	
	17	
	18	

FIG. 16C

	HEADER ROW				DATA ROW
PAGE TYPE	START ROW	START FLAG	SrvCat FILTER	Srv # FILT	TEXT
GLOBAL	7	1	---	--	"YOU ARE NOT AUTHORIZED FOR"
TV	9	0	TV	--	"THE PRIME_TIME MOVIE CHANNEL"
RADIO	11	0	RADIO	--	"RADIO SERVICE"
RADIO 1	9	0	RADIO	1	"EASY-LISTENING"
RADIO 2	9	0	RADIO	2	"HARD ROCK"
RADIO 3	9	0	RADIO	3	"CLASSICAL"

FIG.17

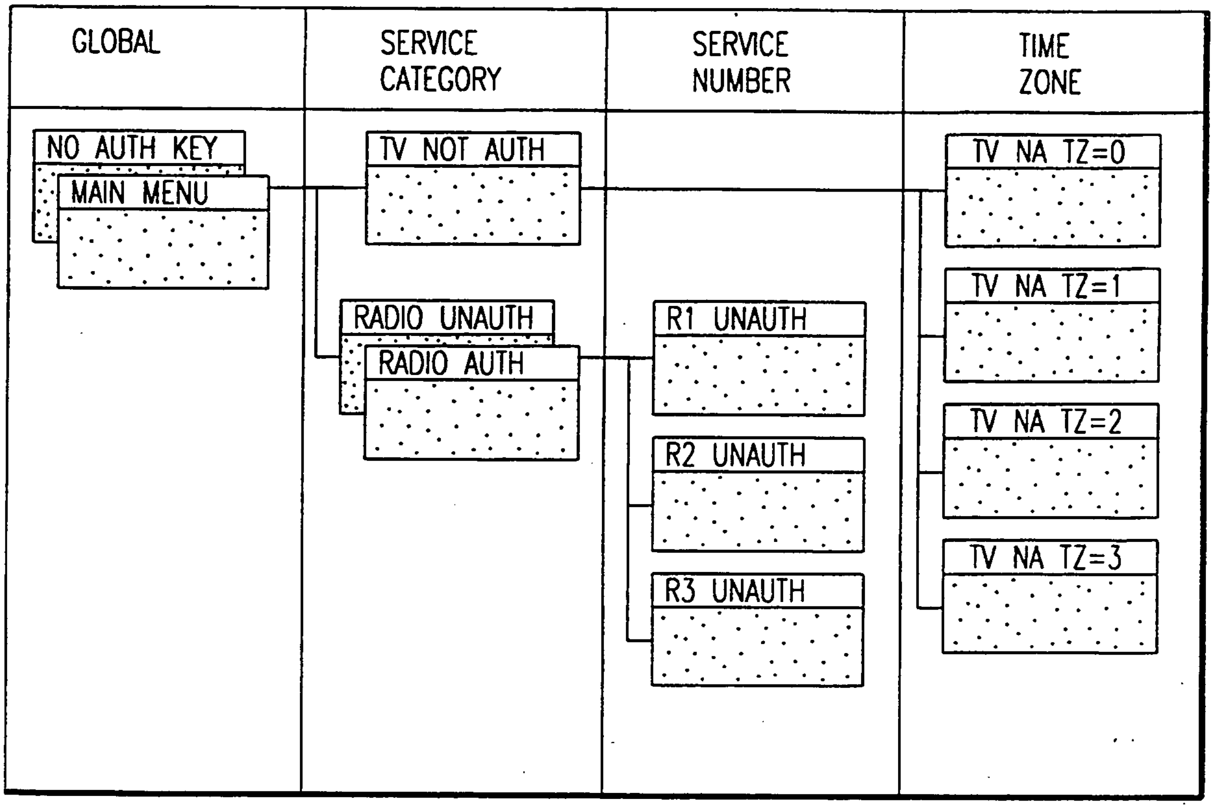

GLOBAL
SERVICE CATEGORY
SERVICE NUMBER
TIME ZONE
NO AUTH KEY
MAIN MENU
TV NOT AUTH
RADIO UNAUTH
RADIO AUTH
R1 UNAUTH
R2 UNAUTH
R3 UNAUTH
TV NA TZ=0
TV NA TZ=1
TV NA TZ=2
TV NA TZ=3

FIG.18

PROT	ROW	TV TIME ZONE 1 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	$\boxed{\text{THE PRIME-TIME MOVIE CHANNEL}}$
CAT	11	THE NEXT SHOW STARTS:
T2	12	1:00 PM
	13	
	14	
	15	
	16	
	17	
	18	

FIG.19A

PROT	ROW	TV TIME ZONE 2 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	$\boxed{\text{THE PRIME-TIME MOVIE CHANNEL}}$
CAT	11	THE NEXT SHOW STARTS:
T2	12	2:00 PM
	13	
	14	
	15	
	16	
	17	
	18	

FIG.19B

PROT	ROW	TV TIME ZONE 3 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	THE PRIME-TIME MOVIE CHANNEL
CAT	11	THE NEXT SHOW STARTS:
T2	12	3:00 PM
	13	
	14	
	15	
	16	
	17	
	18	

FIG.19C

PROT	ROW	TV TIME ZONE 4 "SERVICE NOT AUTHORIZED" PAGE
	1	
	2	
	3	
	4	
	5	
	6	
GBL	7	
	8	
CAT	9	YOU ARE NOT AUTHORIZED FOR
	10	THE PRIME-TIME MOVIE CHANNEL
CAT	11	THE NEXT SHOW STARTS:
T2	12	4:00 PM
	13	
	14	
	15	
	16	
	17	
	18	

FIG.19D

PAGE TYPE	HEADER ROW					DATA ROW
	START		FILTERS			
	ROW	FLAG	CAT	Srv #	TZ	TEXT
GLOBAL	7	1	---	--	--	"YOU ARE NOT AUTHORIZED FOR"
TV	9	0	TV	--	--	"THE PRIME_TIME MOVIE CHANNEL"
						" "
						"THE NEXT SHOW STARTS:"
TV TZ1	12	0	TV	--	1	"1:00 PM"
TV TZ2	12	0	TV	--	2	"2:00 PM"
TV TZ3	12	0	TV	--	3	"3:00 PM"
TV TZ4	12	0	TV	--	4	"4:00 PM"
RADIO	11	0	RADIO	--	--	"RADIO SERVICE"
RAD 1	9	0	RADIO	1	--	"EASY-LISTENING"
RAD 2	9	0	RADIO	2	--	"HARD ROCK"
RAD 3	9	0	RADIO	3	--	"CLASSICAL"

FIG.20

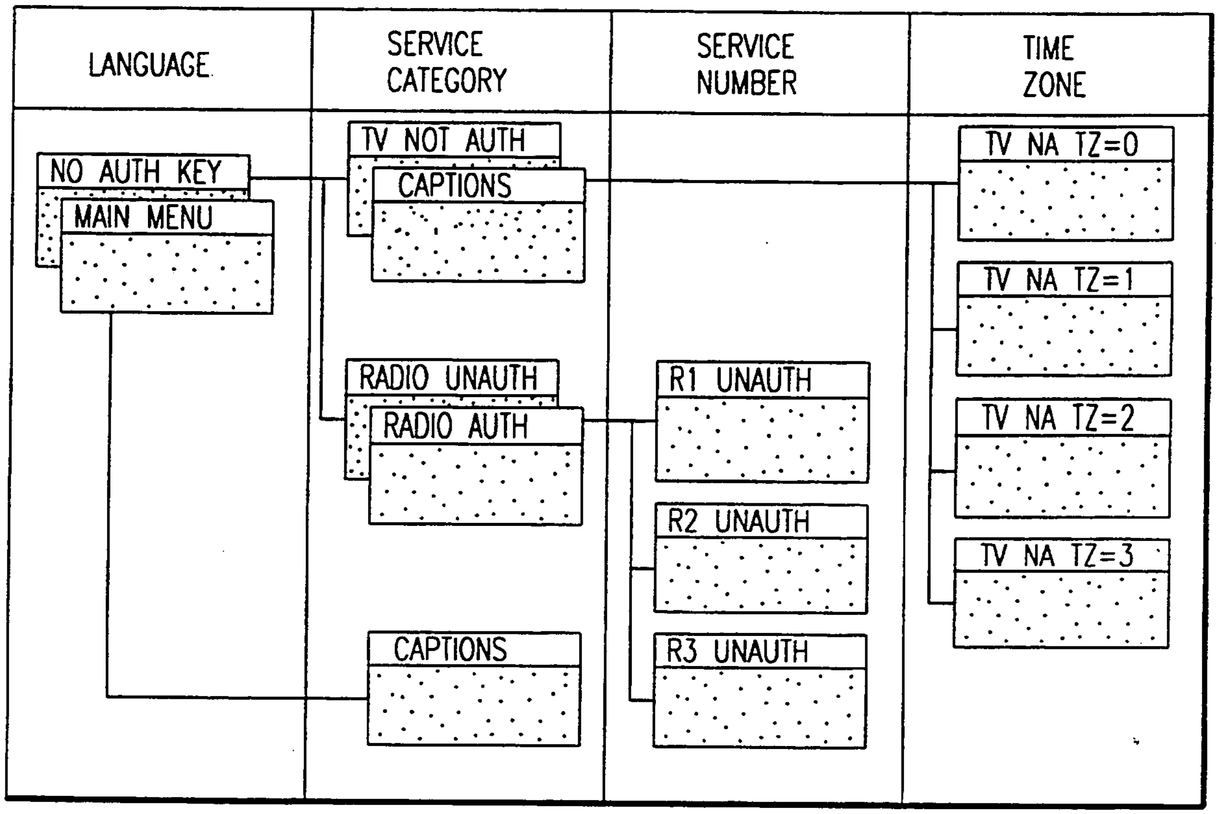


FIG.21

USER	FILTER	SCOPE	RIGHTS
TTX ADMIN	LANGUAGE	ALL	CREATE
	CATEGORY	ALL	CREATE
	SERVICE #	ALL	CREATE
	TIME ZONE	ALL	CREATE

FIG.22

USER	FILTER	SCOPE	RIGHTS
TTX ADMIN	LANGUAGE CATEGORY SERVICE # TIME ZONE	ALL ALL ALL ALL	CREATE CREATE CREATE CREATE
TV MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL TV ALL ALL	VIEW CREATE CREATE CREATE
RADIO MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO ALL ALL	VIEW CREATE CREATE CREATE

FIG.23

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G				8
G				9
G				10
G				11
G				12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18
G	G	G	G	19

YOU ARE NOT AUTHORIZED FOR

FIG.24A

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G	TV			8
G	TV			9
G	TV			10
G	TV			11
G	TV			12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18

YOU ARE NOT AUTHORIZED FOR

THE PRIME-TIME MOVIE CHANNEL

FIG.24B

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G	RAD			8
G	RAD			9
G	RAD			10
G	RAD			11
G	RAD			12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18

YOU ARE NOT AUTHORIZED FOR

EASY-LISTENING RADIO

FIG.24C

USER	FILTER	SCOPE	RIGHTS
TTX ADMIN	LANGUAGE CATEGORY SERVICE # TIME ZONE	ALL ALL ALL ALL	CREATE CREATE CREATE CREATE
TV MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL TV ALL ALL	VIEW CREATE CREATE CREATE
RADIO MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO ALL ALL	VIEW CREATE CREATE CREATE
RADIO 1	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO 1 ALL	VIEW VIEW EDIT CREATE
RADIO 2/3	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO 2,3 ALL	VIEW VIEW EDIT CREATE

FIG.25

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G	RAD	G		8
G	RAD	1		9
G	RAD	G		10
G	RAD	G		11
G	RAD	G		12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18
G	G	G	G	19

YOU ARE NOT AUTHORIZED FOR

RADIO SERVICE

FIG.26A

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G	RAD	G		8
G	RAD	1		9
G	RAD	G		10
G	RAD	G		11
G	RAD	G		12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18

YOU ARE NOT AUTHORIZED FOR

EASY-LISTENING

RADIO SERVICE

FIG.26B

USER	FILTER	SCOPE	RIGHTS
TTX ADMIN	LANGUAGE CATEGORY SERVICE # TIME ZONE	ALL ALL ALL ALL	CREATE CREATE CREATE CREATE
TV MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL TV ALL ALL	VIEW CREATE CREATE CREATE
TV TZ	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL TV ALL ALL	VIEW VIEW VIEW EDIT
RADIO MGR	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO ALL ALL	VIEW CREATE CREATE CREATE
RADIO 1	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO 1 ALL	VIEW VIEW EDIT CREATE
RADIO 2/3	LANGUAGE CATEGORY SERVICE # TIME ZONE	GLOBAL RADIO 2,3 ALL	VIEW VIEW EDIT CREATE

FIG.27

LNG	CAT	S#	TZ	ROW
G	G	G	G	1
G	G	G	G	2
G	G	G	G	3
G	G	G	G	4
G	G	G	G	5
G	G	G	G	6
G	G	G	G	7
G	TV			8
G	TV			9
G	TV			10
G	TV			11
G	TV		1	12
G	G	G	G	13
G	G	G	G	14
G	G	G	G	15
G	G	G	G	16
G	G	G	G	17
G	G	G	G	18

YOU ARE NOT AUTHORIZED FOR

THE PRIME-TIME MOVIE CHANNEL

THE NEXT SHOW STARTS:
1:00 PM

FIG.28

USER	FILTER	SCOPE	RIGHTS
TTX ADMIN	LANGUAGE	ALL	CREATE
	CATEGORY	ALL	CREATE
	SERVICE #	ALL	CREATE
	TIME ZONE	ALL	CREATE
TV MGR	LANGUAGE	GBL, 1	CREATE
	CATEGORY	TV	CREATE
	SERVICE #	ALL	CREATE
	TIME ZONE	ALL	CREATE
TV TZ	LANGUAGE	GLOBAL	VIEW
	CATEGORY	TV	VIEW
	SERVICE #	ALL	VIEW
	TIME ZONE	ALL	EDIT
RADIO MGR	LANGUAGE	GLOBAL	VIEW
	CATEGORY	RADIO	CREATE
	SERVICE #	ALL	CREATE
	TIME ZONE	ALL	CREATE
RADIO 1	LANGUAGE	GLOBAL	VIEW
	CATEGORY	RADIO	VIEW
	SERVICE #	1	EDIT
	TIME ZONE	ALL	CREATE
RADIO 2/3	LANGUAGE	GLOBAL	VIEW
	CATEGORY	RADIO	VIEW
	SERVICE #	2,3	EDIT
	TIME ZONE	ALL	CREATE

FIG.29

LNG	CAT	S#	TZ	ROW	
G	TV			1	
G	TV			2	
G	TV			3	
G	TV			4	
G	TV			5	
G	TV			6	
G	TV			7	
G	TV			8	
G	TV			9	
G	TV			10	
G	TV			11	
G	TV			12	
G	TV			13	
G	TV			14	
G	TV			15	
G	TV			16	
G	TV			17	
G	TV			18	
G	TV			19	
G	TV			20	

FIG.30A

LNG	CAT	S#	TZ	ROW	
1	TV			1	
1	TV			2	
1	TV			3	
1	TV			4	
1	TV			5	
1	TV			6	
1	TV			7	
1	TV			8	
1	TV			9	
1	TV			10	
1	TV			11	
1	TV			12	
1	TV			13	
1	TV			14	
1	TV			15	
1	TV			16	
1	TV			17	
1	TV			18	
1	TV			19	
1	TV			20	

FIG.30B

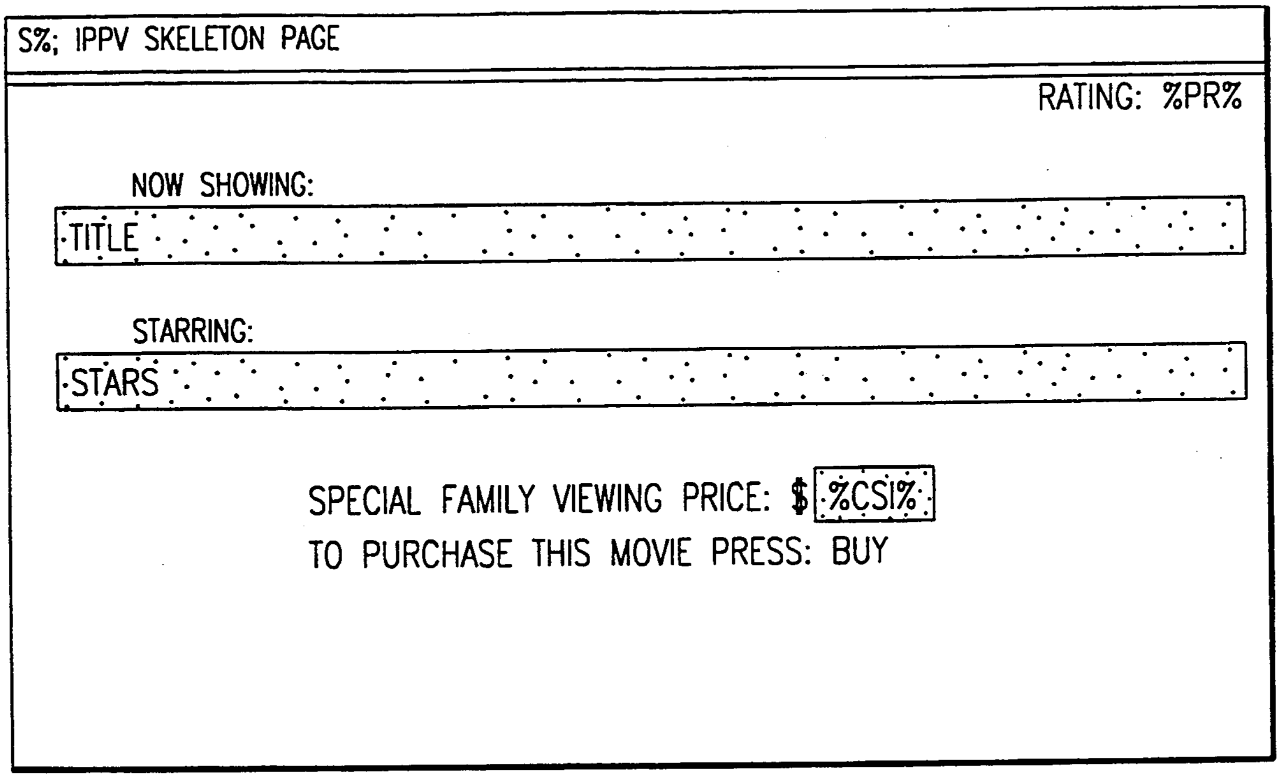


FIG.31A

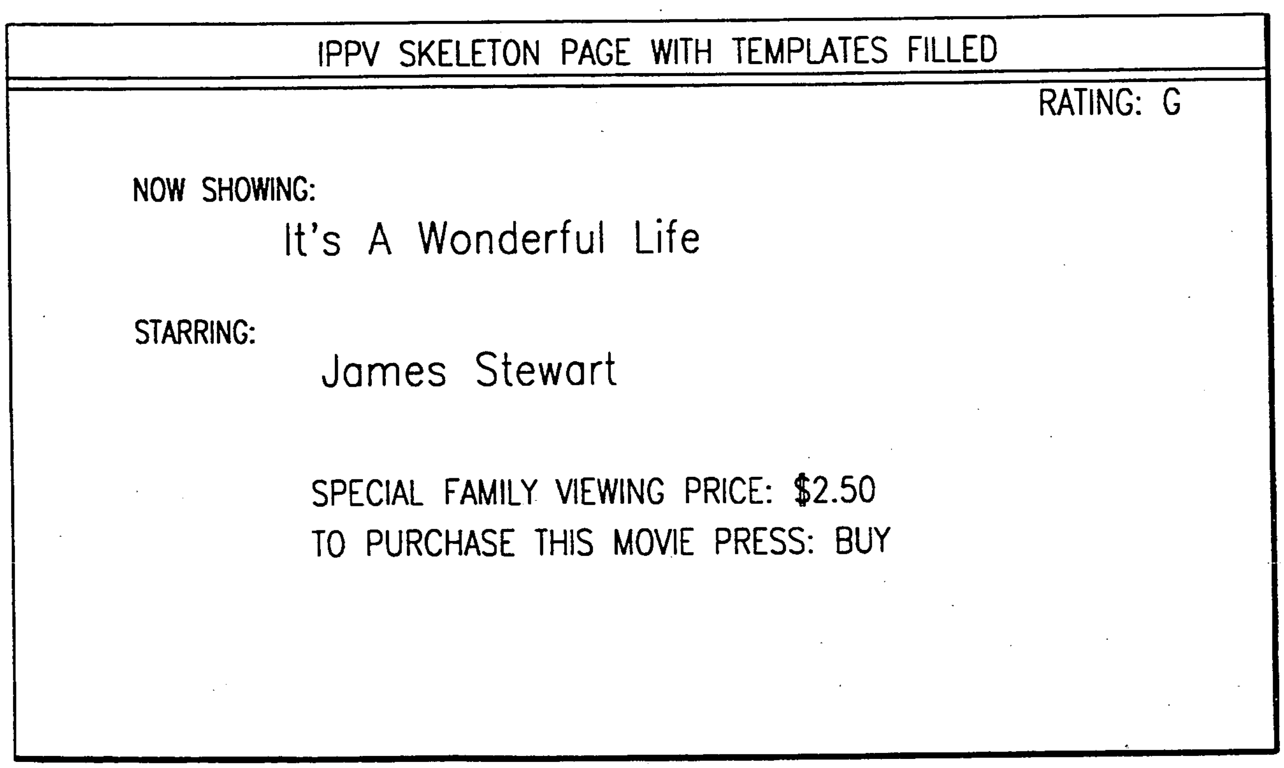


FIG.31B

PAGE	DESCRIPTION	CATEGORY	SERVICE	CONTROL
0000-EFFF	STANDARD EPG	DISABLED	DISABLED	1
F000-FFFF	DECODER MENU/CONTROL	DISABLED	DISABLED	1
0000-FFFF	TELETEXT SERVICE n	TTXi	n	0
0000-FFFF	NON-TTX SERVICE n	NOT TTX	n	0
0000-FFFF	PERSONAL MESSAGE SERVICE n	TTX	n	0

FIG.32A

PAGE	DESCRIPTION	CATEGORY	SERVICE	CONTROL
0000-FFFF	DECODER MENU/CONTROL	DISABLED	DISABLED	1
0000-FFFF	TELETEXT SERVICE n	TTXi	n	0
0000-FFFF	NON-TTX SERVICE n	NOT TTX	n	0
0000-FFFF	PERSONAL MESSAGE SERVICE n	TTX	n	0
0000-FFFF	TTX SERVICE EPG	TTX	n	0

FIG.32B

TES #	USAGE	TES # DELIVERY
0 . . . 14	TTX SERVICE 0 . . . TTX SERVICE 14	VIRTUAL CHANNEL'S PHYSICAL TEXT SERVICES # FIELD FILLED WITH THE SERVICE #. TTX SERVICE EPG OCCUPY THIS RANGE.
15 . . . 29	NON-TTX SERVICE . . . NON-TTX SERVICE	VIRTUAL CHANNEL'S PHYSICAL TEXT SERVICE # FILLED WITH TES #
30	PERSONAL MESSAGE	ADP
31	NETWORK CONTROL, BROADCAST, STANDARD EPG	IMPLIED BY MSK.

FIG.33

FEATURE	PAGE RANGE	CATEGORY / SERVICE #	TES #
SERVICE RELATED	0000 - CFFF	NETWORK CONFIGURED	FILTER MAPPED
PERSONAL MESSAGE	D000 - DFFF	DISABLED	30
STANDARD EPG	E000 - EFFF	DISABLED	31
NETWORK CONTROL	F000 - FFFF	NETWORK CONFIGURED	31

FIG.34

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/13846

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : HO4N 7/025, 7/16
US CL :348/465, 467, 468; 380/49
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/465, 467, 468; 380/49, 48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,916,539 (GALUMBECK) 10 APRIL 1990, FIG 1 AND COL.'S 4 AND 5	1-5,7,9,11 AND 16.
X	US, A, 4,393,404 (COX ET AL) 12 JULY 1983, COL. 7, LINES 8-35 AND FIG. 4	1-5 AND 7.
A	US, A, 4,115,662 (GUINET ET AL.) 19 SEPTEMBER 1978, COL. 2, LINES 37-61.	1 AND 16
A	US, A, 4,862,268 (CAMPBELL ET AL.) 29 AUGUST 1989, COL. 5, LINES 7-15.	1
A	US, A, 5,200,823 (YONEDA ET AL.) 06 APRIL 1993, COL. 13, LINE 4 THROUGH COL. 14, LINE 9.	1
A	US, A, 4,890,321 (SETH-SMITH ET AL.) 26 DECEMBER 1989, FIG. 10.	10 AND 13

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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Facsimile No. (703) 305-3230

Authorized officer Diane Goodwin for
GILBERTO BARRÓN, JR.
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(71) Applicant: PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant *(for SE only)*: PHILIPS NORDEN AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE).

(72) Inventors: CLARK-SCHREYER, Veronika; Wiedner Hauptstrasse 33/12, A-1040 Vienna (AT). ERKINGER, Erwin; Meißauergasse 30, A-1220 Vienna (AT).

(74) Agent: SCHMITZ, Herman, J., R.; Internationaal Octrooibureau B.V., P.O. Box 220, NL-5600 AE Eindhoven (NL).

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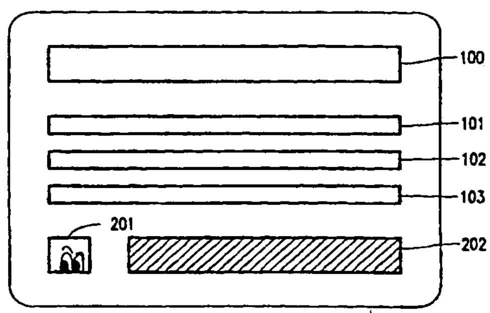

(57) Abstract

A method and arrangements for transmitting, receiving and displaying graphic images. The graphic images include dynamic icons (dynacons), i.e. graphic subpictures comprising two or more motion phases. By alternately displaying said motion phases, an attractive motion is created. They enhance the appearance of graphic images considerably. This is especially useful in the transmission of an electronic television program guide, e.g. to indicate the type of television programs to come.

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Transmission of graphic images.

The invention relates to a method of transmitting graphic images, comprising the step of transmitting data defining pixels of a displayable subpicture, and the step of transmitting data invoking said subpicture for display on a receiver. The invention also relates to a television receiver and a display device for receiving and displaying said graphic images.

A method of transmitting graphic images is generally known as teletext. Herein, images are transmitted in the form of pages, each page comprising a plurality of character codes defining the alphanumeric and graphical characters of said page. Pixel patterns defining the commonly used characters are stored in a read-only memory section of the receiver. The known arrangements render it possible for characters, or series of characters, to "flash", i.e. to be concealed and revealed at a predetermined frequency. This allows a dynamic effect to be added to a page.

More sophisticated teletext systems (level 3) provide a feature usually referred to as "Dynamically Redefinable Character Sets". This feature allows a page editor to define the pixel pattern of characters at the transmitter end, and to download said patterns to the receiver for storage in a random access memory prior to the transmission of the page.

It is an object of the invention to further improve the appearance of an image on screen.

According to the invention, the method is characterized in that the step of transmitting pixel defining data includes the transmission of pixel defining data for at least two motion phases of said subpicture to be displayed cyclically. The transmission step may include the transmission of a time code representing a time interval between displaying the successive motion phases of said subpicture. The graphic image can thus be enhanced with dynamic icons ("dynacons").

Fig.1 shows a system comprising a transmitter and a receiver according to the invention.

Fig.2 shows a flowdiagram of transmission steps executed by the transmitter of Fig.1.

Figs. 3-7 show examples of subpictures having different motion phases for display by the receiver shown in Fig.1.

Fig.8 shows an image to be displayed by the receiver of Fig.1.

Fig.9 shows a flow chart of operations carried out by a microprocessor shown in Fig.1.

Figs. 10-12 show embodiments of the display section of the receiver shown in Fig.1.

The invention will now be described with reference to the transmission of menus for accessing a (separately transmitted) electronic TV programme guide. The invention, however, is not restricted to this application. Fig.1 shows a system comprising a transmitter **1** and a receiver **2** according to the invention. The transmitter comprises an editing terminal **11** for creating textual and graphical information, a processor **12**, a memory **13** for storing the information, and a page composer **14** for packing the information into teletext pages TXT. The transmitter further comprises a teletext inserter **15** for inserting the teletext pages in the flyback period of a composite video signal CVBS. The thus obtained television signal is applied to a modulator **16** for broadcast over a transmission medium 3.

The receiver comprises a tuner **21** for receiving the television signal. The received signal is directly applied to a television monitor **22** so as to display the television programme. The signal is also applied to a teletext data decoder **23** which is adapted to acquire selected teletext pages and to store them in a memory **24**. A microprocessor **25** is connected to decoder **23** so as to apply the relevant page numbers, and is further connected to the memory **24** so as to process the information stored therein. The receiver further comprises a graphic generator **26** adapted to read a predetermined display segment of memory **24** and to generate an On-Screen-Display picture OSD defined by data stored in said memory segment. The OSD picture includes a cursor, the position of which is defined by the microprocessor in response to positioning signals from a remote cursor control device **27**.

In practice, the receiver described above may take the form of a videorecorder. The videorecorder may have an embedded display device **22** or an output for applying the display signals CVBS and OSD to a separate display device **22** such as a television set.

Operation of the transmitter

The electronic programme guide as well as the menus for accessing and presenting the programme guide are created by editorial staff using editing terminal **11**. The information is processed by processor **12** and stored in various segments of memory **13**. Each memory segment defines an amount of data which will further be referred to as a section of the database. The page composer **14** packs each section in one or more teletext pages. As the teletext pages are not intended for direct display, they have hexadecimal page numbers. Data which is most sensible data to transmission errors, such as headers, dates and times, string lengths, teletext page numbers, etc., are protected by a Hamming code. The first teletext page has a predetermined page number (e.g. 3A0) and contains a table of content. This is a list of teletext page numbers carrying the data stream. If the table of content does not fit in one teletext page, a reference to subsequent teletext pages is made.

Fig.2 shows a flowdiagram of transmission steps executed by the transmitter of Fig.1. Each step represents the transmission of a section of the database. Each section relates to a certain functionality and comprise data items such as parameters, values, text strings, attributes, etc. In a step **31**, a Basic Info section is transmitted comprising basic data such as date and time and some other general data so as to ease the management of memory in a television receiver. In a step **32**, a Layout Info section is transmitted defining a variety of design tools for composing the electronic programme guide. In a step **33**, a Graphics section is transmitted in which a plurality of graphic subpictures is defined for display on screen. In a step **34**, a Menu Info section is transmitted conveying the menus for accessing the program guide. In a step **35**, a Programme Info section is transmitted for building up the TV programme guide database. The transmission of the database ends with a step **36** of transmitting an End-of-Protocol code. The database is transmitted regularly, e.g. a few times per day.

The sections will now be described in more details. As not all section are equally essential to the invention, some sections will only briefly be discussed. In the following description,. sections are shown in double framed boxes. A collection of data items

in a section may constitute a block. Blocks are shown in single framed boxes. A ++ symbol is placed next to a data item or block if it is repeatedly transmitted. For example, a section:

item_1	
item_2 *item_3*	++

comprises three data items of which the block comprising *item_2* and *item_3* may be repeated. Each section starts with a header. This is a code identifying the section and indicating its beginning. The type of the data items (such as byte, character, string) is not given here because it is not essential to the invention.

<u>The section Basic Info</u>

This section comprises basic data such as date and time and some other general data so as to ease the management of memory in a television receiver. The Basic Info section has the following format:

BASIC_HEADER
date
time
no_programmes
no_menuitems
no_graphics
poolsize

Herein, *date* and *time* represent the date and time of issue of the database. *No_programmes* is the number of television programmes contained in the Programme Info section. *No_menuitems* is the number of menu items in the Menu Info section. *No_graphics* is the total number of graphics, including the logos defined in the Table Info section. *Poolsize* is the total size of all the titles, programme infos and descriptions and criteria names.

<u>The section Layout Info</u>

This section gives a variety of design tools to the supplier of the electronic programme guide. The format of this section is:

LAYOUT_HEADER *no_of_colours* *colour++* *screensize* *no_of_arrgmts*		
no_of_levels		
level *layout_data*	++	++

No_of_colours and *colour++* define the length and contents, respectively, of a colour look up table. By default, a standard teletext colour table is used. The rest of the section specifies the appearance of the various menus on screen. *Screensize* gives the full screen size in pixels, in horizontal and vertical direction. Because the menus are organized in a tree structure, each menu is assigned a *level* of which there are *no_of_levels* available. As will be described later, two menus of different levels may be displayed simultaneously. This is referred to as an "arrangement". The number of arrangements is specified by *no_of_arrgmnts*. The item *layout_data* is a block of data defining features such as height, font, colours, position, spacing, etc., of headlines and menu items of the menu.

<u>The section Graphics</u>

In this section, one or more graphic subpictures (hereinafter also referred to as "graphics" for short) are defined which can be displayed on screen. The general format of this section is:

GRPHC_HEADER *no_grphcs*	
grphc_no *graphic*	++

Herein, *no_grphcs* gives the number of graphics defined in the section. *Grphc_no* is an index number for invoking the subpictures. The data item *graphic* itself is a block of data defining a rectangular subpicture. Four types of graphics are being distinguished in this protocol: bitmaps, symbols, dynacons, and text strings. A bitmap is the general term for a graphic. It is a rectangular matrix of pixels forming a subpicture. Symbols and dynacons are bitmaps as well, but with special conventions. Symbols are intended for use within text strings. A text including a symbol comprises an escape character followed by *graphic_no* to invoke the symbol. Dynacons consist of a predefined sequence of 2 or more bitmaps. Each bitmap represents one motion phase of the dynacon. By cyclically displaying said motion phases, the viewer sees one bitmap after the other, which becomes manifest as a simple animation of the subpicture. The period of time during which each phase is to be displayed can be fixed in the receiver, or may be transmitted as a data item in the section. A dynacon with one single phase is a symbol. The phases "overload" the colour table, per phase there is one complete colour table as common from a bitmap. Dynacons can be used like symbols. Figs. 3-7 show examples of dynacons, each having two motion phases. The two motion phases shown in Fig.3 give an impression of blinking eyes for drawing the user's attention to a particular piece of information. Figs. 4-7 are intended to be added to a preview of a television programme. Fig.4 represents a movie, Fig.5 represents a programme for children, Fig.6 a live performance, and Fig.7 shows two phases giving an impression of flapping wings so as to represent a documentary film about the bird's life.

Bitmaps, symbols and dynacons may be encoded either pixel-by-pixel or by using a run-length code. Both the type of graphics and the method of encoding are defined by the section header which has a plurality of possible values for this purpose.

For pixel-by-pixel encoded bitmaps, symbols and dynacons, the format of the block *graphic* is:

```
bits_per_colour
colour_table
x_tlcorner
y_tlcorner
x_xtns
y_xtns
pixel_block
```

Herein, *bits_per_colour* defines the number of colours which can be used, and *colour_table* is an array of three values defining each colour in terms of red, green and blue levels. The parameters *x_tlcorner* and *y_tlcorner* define the position of the bitmap on screen in terms of a character location. The parameters *x_xtns* and *y_xtns* define the size of the bitmap on the screen in pixels. *Pixel_block* defines the colour of each pixel in terms of an index to the colour look up table in a predetermined scanning order. Every colour index consists of *bits_per_colour* bits.

For run-length-encoded bitmaps, symbols and dynacons, the format of the block *graphic* is:

```
bits_per_colour
colour_table
x_tlcorner
y_tlcorner
x_xtns
y_xtns
pblsize
pixel_block
```

The same definitions as above apply. The parameter *pblsize* defines the size of *pixel_block* which now accommodates a plurality of run-length codes. Methods for run-length coding graphic images are generally known.

The section Menu Info

The section Menu Info conveys the menus to access the program guide and can also be used to transport non-programme information, e.g. news or help. It defines a hierarchically structured tree of charts, each chart consisting of a headline and several items. Each item may expand to a new, more detailed sub chart. The transmission format of the section Menu Info is shown in the following Table:

MENU_HEADER *no_of_items*	
item_no *level* *menu_item* *no_of_attributes* *attribute* ++	++

Item_no is an item number assigned to a *menu_item* in the range from 0 up to and inclusive *no_of_items*-1. *Level* is an unsigned number, telling how deep in the tree the menu comprising this item lays. *Menu_item* is a string of characters representing an information item. The first *menu_item* at a given level of a menu is the headline of said menu.

Basically, the text string defined by *menu_item* is to be displayed as such as a menu item on screen. However, if its first character is a special character, *menu_item* represents a reference to a string stored elsewhere in a television receiver, e.g. a piece of text in a particular teletext page, or a programme title transmitted in the Programme Info section.

Each *menu_item* in the section may have zero, one or more *attributes* assigned to it, the number of attributes being given by *no_of_attributes*. An attribute is a block of data comprising a header defining the attribute as well as the kind and format of the subsequent data. Some attributes enhance or extend the menu item, others define a criterion to be applied to the stored information items so as to obtain a list of information items fulfilling said criterion. Some examples of attributes will now be described.

Attributes INS_DATE and INS_TIME specify that the current date and/or time are to be inserted in the menu item. A specification of the display format (e.g. "14:22" or "2.22 a.m.") may be included.

An attribute GRPHCS specifies the *graph_no* of a graphic subpicture to be displayed. If the attribute is connected to a menu headline (the first *menu_item* at a given

level), the subpicture is to be displayed during the time that the relevant menu is displayed. If the attribute is connected to selectable menu items, the subpicture pops up when the cursor touches that item on screen.

An attribute LINKEDITEM establishes a link between a menu item and other displayable information so as to display both simultaneously. Some possible links (e.g. to graphic subpictures) have already been mentioned. The attribute can be added to menu items as well as programmes (see section Programme Info). The display area where to put the linked element on screen is specified. The linked item is displayed whenever the item with the attribute is the only one on the screen or whenever the cursor touches it. Links can be established to an element of a different section or to a (piece of a) teletext page. A link can also by itself define a text string to be displayed. This is defined by a code immediately following the attribute header.

An attribute MULTILEVEL instructs the receiver to display two levels of a menu simultaneously on one screen. The attribute is added to the headline of a menu at a given level, and specifies whether the next higher level or the next lower level is to be displayed.

The section Programme Info

Whereas the section Menu Info is to construct a menu tree to navigate through the database, the section Programme Info is to build up the database of television programmes. The section conveys all programmes, which become available within the program guide, and contains all the necessary information needed for searching programmes fulfilling a certain criterion (e.e. data and time of transmission, category). A detailed explanation is omitted here as it is not relevant to the invention.

Example of a menu page

Fig.8 shows an example of a menu page to be displayed. The menu comprises a headline **100** (e.g. the string "MAIN MENU"), a first menu item **101** (e.g. "TV Guide"), a second menu item **132** ("FastFinder") and a third menu item **150** ("User's Guide"). The image further includes a subpicture **202**, e.g. an important broadcaster message. In order to draw the user's attention to said message, a dynacon **201** is displayed next to it. The relevant data in the section Menu Info for defining the screen of Fig.8 is: Herein, item number 0 defines the headline whereas item numbers 1-3 define three menu items which are selectable the user. The two attributes {GRPHCS,...} attached to the

item_no=0, *level*=0, *item*="MAIN MENU", *no_of_attributes*=2,
attribute={GRPHCS,..},{GRPHCS,..};
item_no=1, *level*=0, *item*="TV Guide", *no_of_attributes*=0;
item_no=2, *level*=0, *item*="FastFinder", *no_of_attributes*=0;
item_no=3, *level*=0, *item*="User Guide", *no_of_attributes*=0;

headline invoke subpictures **201** and **202** to be displayed. The attributes include a parameter *graphic_no* (see Graphic Info section) so as to identify the location of the subpicture in the relevant memory segment of the receiver.

Operation of the receiver

The operation is determined by a control program stored in a memory of microprocessor **25** (Fig.1). Fig.9 shows a flow chart of operations carried out by the microprocessor. In an initial step **41**, the processor determines the sequence of teletext pages constituting the database. As already mentioned above, a predetermined page comprises the list of pages to be acquired. In the step **41**, the processor applies the relevant page numbers to the data decoder **23** (Fig.1). As each page arrives, the data accommodated therein are stored in memory **24** (Fig.1). The processor sorts the received data so as to store each section of the database in a corresponding segment of said memory. During this process, the user may use the television receiver for other purposes, e.g. watching a television programma. The process may also be carried out in a standby state of the receiver, e.g. during the night.

A step **42** is executed when the user desires to consult the television program guide. In this step, the processor searches, in the memory segment holding the Menu Info section, all items relevant to the menu to be displayed. For the initial main menu, this step is equivalent to searching all items having *level*=0. In a step **43**, the menu is composed and displayed using the display parameters such as text font, height, spacing, colour, etc. as defined in the Layout Info section stored in a predetermined segment of memory **24** (Fig.1). The processor further checks whether an attribute {GRPHCS,..} is associated with the headline. Actions in response to such an attribute will be described in more details in the paragraph "Description of receiver embodiments".

In a step **44**, the processor controls the position of a cursor displayed on screen in response to cursor positioning signals from remote cursor control device **27** (Fig.1). In a step **45**, the processor determines whether a menu item is selected by the user.

If that is not the case, the processor returns to step **44** so as to reposition the cursor in response to the positioning signals received from remote control device **27** (Fig.1). If a menu item is selected, the processor returns to step **42** so as to display a new menu.

Description of receiver embodiments

Fig.10 shows, in more details, a first embodiment of the display section of receiver **2** (Fig.1). This embodiment relates to a character-based display device. Memory **24** (Fig.1) of the receiver comprises a segment **241** in which a character code is stored for each character to be displayed, a read-only segment **242** keeping the pixel patterns of common alphanumeric symbols, and a random-access memory segment **243** keeping the pixel patterns (D1,D2) of the motion phases of dynacons. The character codes are successively read-out, from left to right and from top to bottom, in response to read addresses supplied by graphic generator **26**. Character codes X representing a common symbol address a respective location in ROM section **242**. Character codes D representing a dynacon address a respective location in RAM section **243**. The pixels stored in the addressed segment are applied to graphic generator **26** and displayed on television monitor **22** (Fig.1). In order to obtain the desired animation, the processor **25** cyclically writes the character codes for motion phases D1 and D2 in memory segment **241**.

Fig.11 shows a second embodiment. This embodiment relates to a bit-mapped device. Memory **24** (Fig.1) of the receiver now comprises a memory segment **244** having a memory location for each individual pixel to be displayed, and a memory segment **245** for keeping the pixel patterns of common alphanumeric symbols as well as the pixel patterns of the motion phases (D1,D2) of dynacons. Both segments are of the RAM type. In order to display an image, the processor **25** copies the relevant pixel patterns stored in segment **245** to segment **244**. The processor alternately writes the pixel patterns D1 and D2 into the part of memory **244** denoted D so as to form a dynacon. The pixels stored in segment **244** are successively read-out, from left to right and from top to bottom, in response to a read address supplied by graphic generator **26**.

Fig.12 shows a third embodiment. A bit-mapped memory segment now comprises two or more layers **247** and **248**, one for each motion phase. In the embodiment shown, two 1-bit layers are provided. Both layers are read-out simultaneously so as to obtain a 2-bits value for each pixel. The pixel values are applied to a colour-look-up-table **261** (CLUT) included in graphics generator **26** (Fig.1) and address a colour definition stored

therein. The processor cyclically updates the CLUT or, what is equivalent, switches between two different CLUTs. The elucidate the operation of this embodiment, motion phase D1 having a 1-bit wide pixel pattern 110 is stored in layer **248** and motion phase D2 having a pixel pattern 011 is stored in layer **247**. The two motion phases are supplied to CLUT **261** as 2-bit wide pixels 01, 11 and 10, successively. For displaying motion phase D1, a background colour B and foreground colour F are stored in the CLUT as indicated in column D1. For displaying motion phase D2, the colours are stored as indicated in column D2. As can readily be understood, the switching from column D1 to column D2 causes the effect of a horizontal piece of a line which moves to the right.

It is noted that the graphic picture data are not necessarily to be accommodated in the vertical flyback period of a broadcast television signal. They can also be transmitted *via* a telephone network or computer network (e.g. Internet), or distributed on storage media such as CDROM or computer diskettes. Accordingly, the receiver may take the form of a data processing and display unit (e.g. a personal computer), provided with an appropriate interface circuit ("extension card") for receiving the data signals.

In summary, a method and arrangements for transmitting, receiving and displaying graphic images is disclosed. The graphic images include dynamic icons (dynacons), i.e. graphic subpictures comprising two or more motion phases. By alternately displaying said motion phases, an attractive motion is created. They enhance the appearance of graphic images considerably. This is especially useful in the transmission of an electronic television program guide, e.g. to indicate the type of television programs to come.

Claims

1. Method of transmitting graphic images, comprising the step of transmitting data defining pixels of a displayable subpicture, and the step of transmitting data invoking said subpicture for display on a receiver, characterized in that the step of transmitting pixel defining data includes the transmission of pixel defining data for at least two motion phases of said subpicture to be displayed cyclically.

2. Method according to claim 1, wherein the step of transmitting pixel defining data further includes the transmission of a time code representing a time interval between displaying the successive motion phases of said subpicture.

3. A transmitter for transmitting graphic images, comprising means for transmitting data defining pixels of a subpicture to be stored in a receiver, and means for transmitting data invoking said subpicture for display on said receiver, characterized in that the means for transmitting pixel defining data is adapted to include the transmission of pixel defining data for at least two motion phases of said subpicture to be displayed cyclically.

4. Transmitter according to claim 3, wherein the means for transmitting pixel defining data is further adapted to include the transmission of a time code representing a time interval between displaying the successive motion phases of said subpicture.

5. A display signal generator for generating graphic image display signals, comprising first memory means for storing data defining pixels of a subpicture, second memory means for storing data invoking said subpicture for display, and display signal generating means for reading said first memory means in response to invoking data stored in said second memory means so as to generate the pixels of the subpicture, characterized in that the first memory means is adapted to store the pixel defining data for at least two motion phases of said subpicture, the display generating means being adapted, in response to the invoking data, to cyclically read from the first memory means the data defining stored pixel invoking data motion phases of the subpictures.

6. A display signal generator according to claim 5, comprising further memory means for storing a time code representing a time interval, wherein the display means is adapted to cyclically read the motion phases stored in response to the invoking data.

7. Receiver for receiving and processing graphic image display signals, said receiver comprising a display signal generator according to any of claims 5 or 6, and further comprising means for receiving and decoding said pixel defining data and invoking data and adapted to store said data in said memory means.

8. Videorecorder, comprising a receiver according to claim 7.

9. A signal representing a graphic image, comprising data defining pixels of a displayable subpicture and data invoking said subpicture for display, characterized in that the pixel defining data includes pixel defining data for at least two motion phases of said subpicture to be displayed cyclically.

10. A storage medium on which a signal according to claim 9 has been stored.

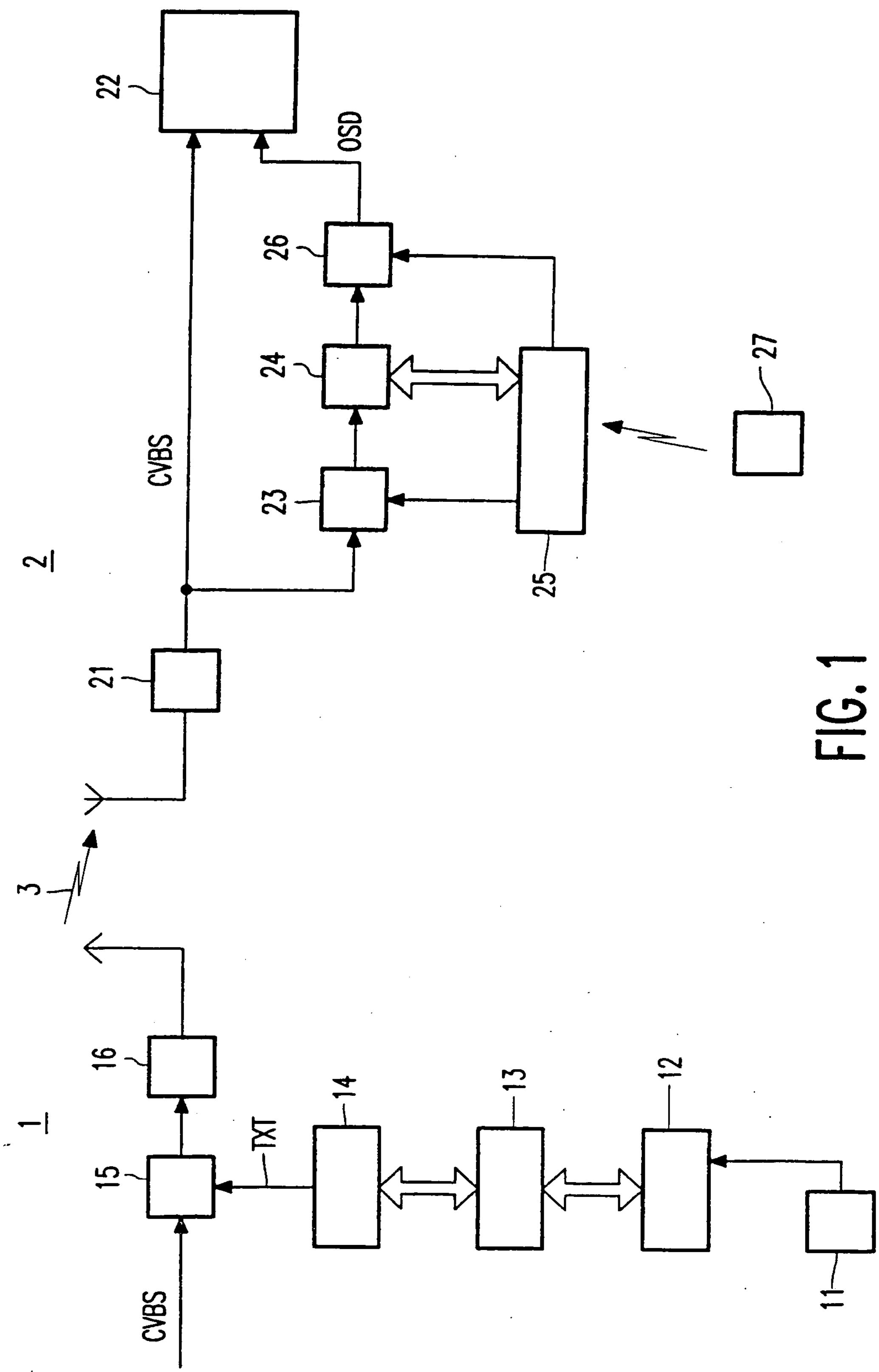

FIG. 1

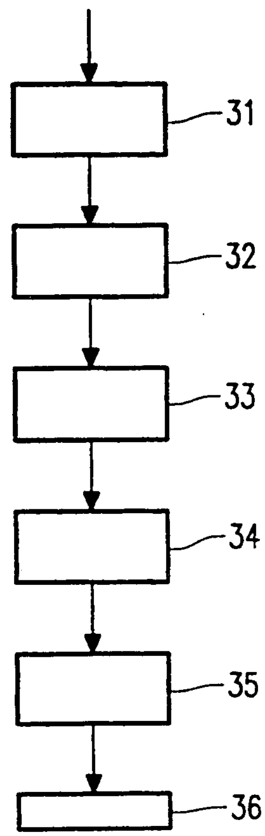

FIG. 2

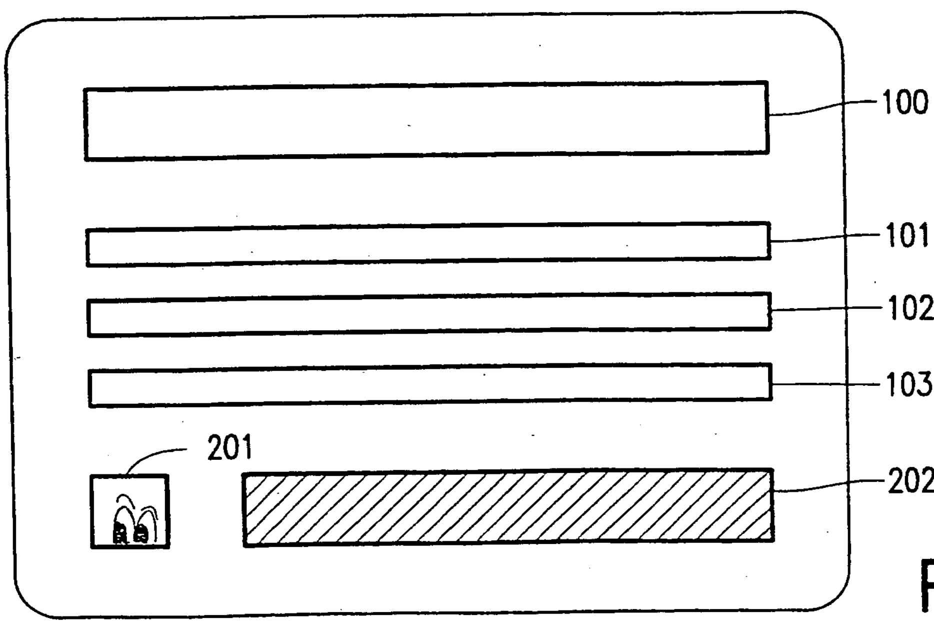

FIG. 8

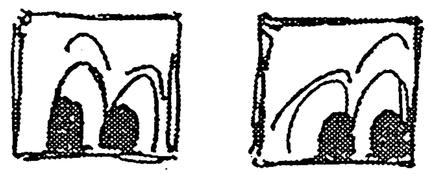

FIG. 3

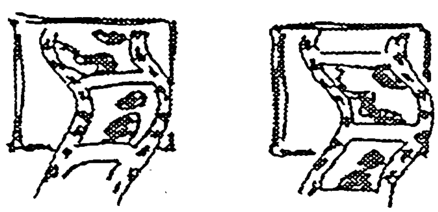

FIG. 4

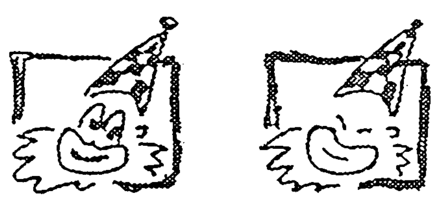

FIG. 5

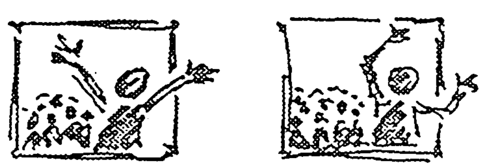

FIG. 6

FIG. 7

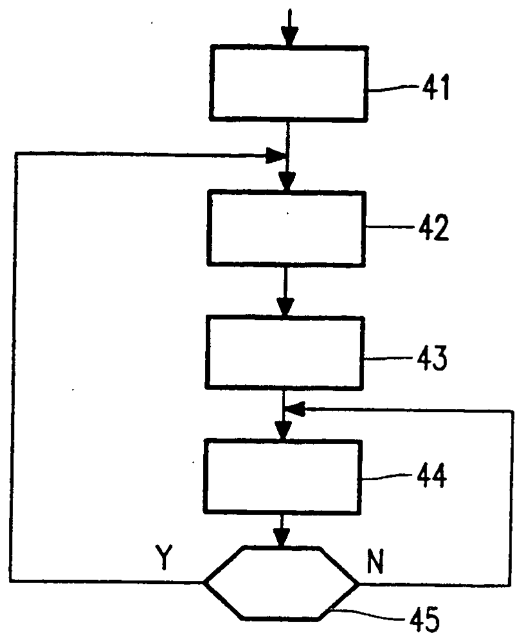

FIG. 9

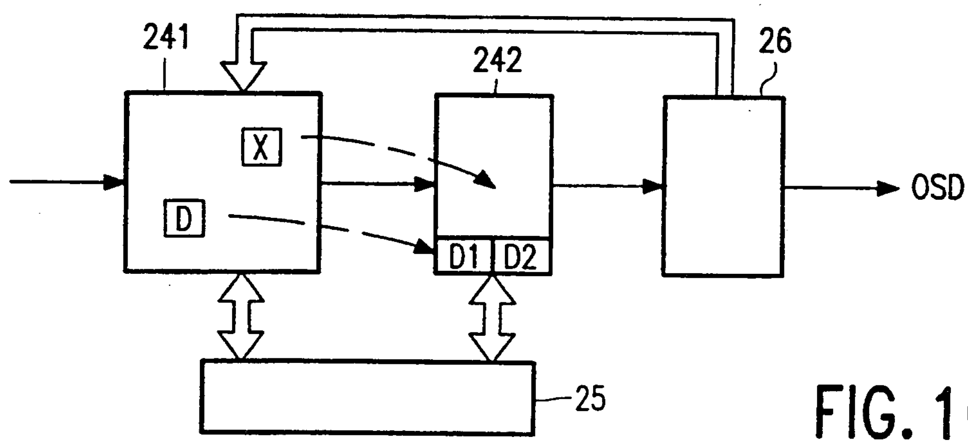

FIG. 10

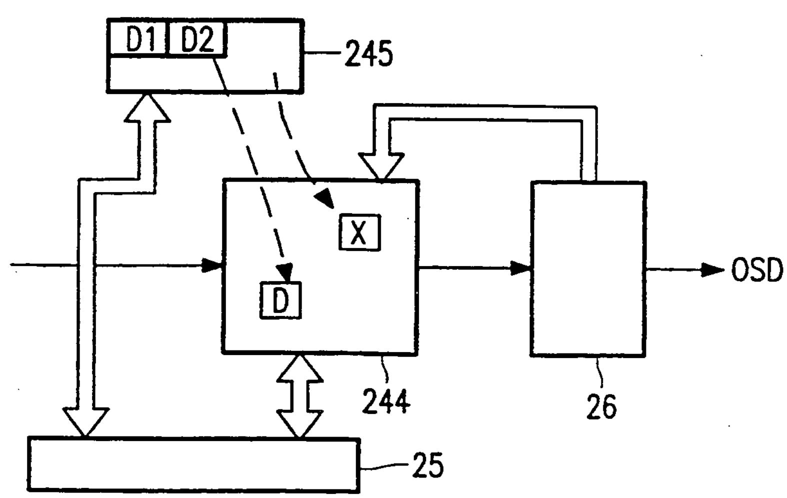

FIG. 11

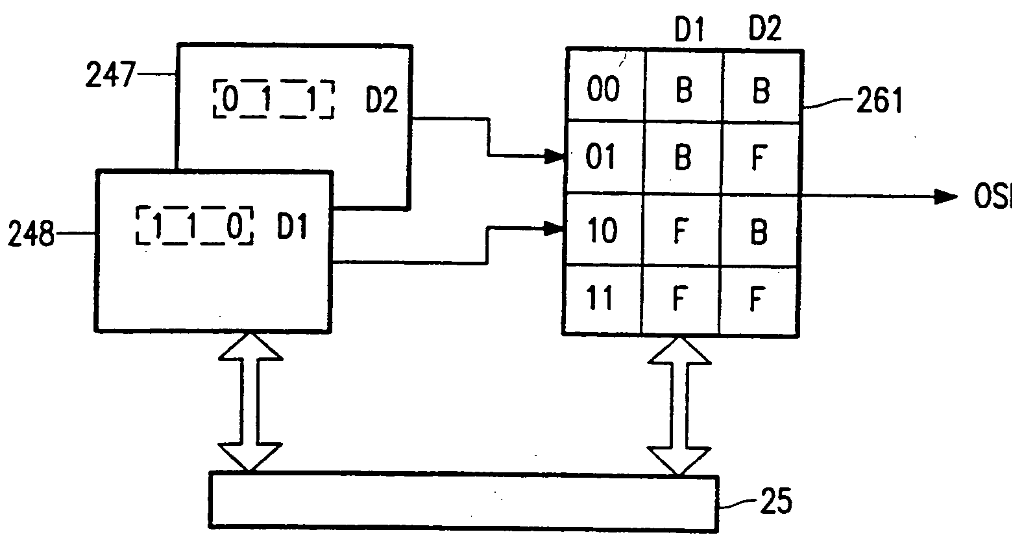

FIG. 12

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(71) Applicant: PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant *(for SE only)*: PHILIPS NORDEN AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE).

(72) Inventors: CLARK-SCHREYER, Veronika; Wiedner Hauptstrasse 33/12, A-1040 Vienna (AT). ERKINGER, Erwin; Meißauergasse 30, A-1220 Vienna (AT).

(74) Agent: SCHMITZ, Herman, J., R.; Internationaal Octrooibureau B.V., P.O. Box 220, NL-5600 AE Eindhoven (NL).

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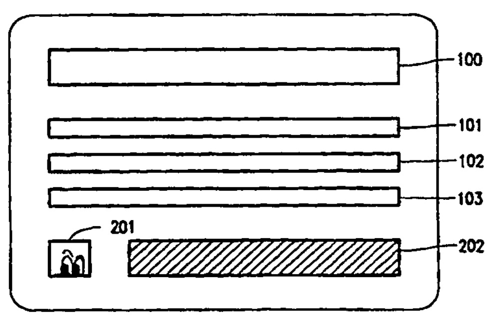

(57) Abstract

A method and arrangements for transmitting, receiving and displaying graphic images. The graphic images include dynamic icons (dynacons), i.e. graphic subpictures comprising two or more motion phases. By alternately displaying said motion phases, an attractive motion is created. They enhance the appearance of graphic images considerably. This is especially useful in the transmission of an electronic television program guide, e.g. to indicate the type of television programs to come.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 96/00629

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04N 7/025, H04N 7/52, H04N 7/088 // H04N 5/445

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, Volume 39, No 4, November 1993, (NEW YORK, US), LEI ET AL, "A New Architecture for a TV Graphics Animation Module"", pages 795-88, XP000423066, see page 795 - page 796 --	1-9
Y	US 5089899 A (S. NOMURA ET AL), 18 February 1992 (18.02.92), claims 1-4, abstract --	1-9
A	EP 0624979 A2 (PHILIPS ELECTRONICS N.V.), 17 November 1994 (17.11.94), claim 1, abstract --	1-9

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

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- "E" ertier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
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- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "&" document member of the same patent family

Date of the actual completion of the international search 29 January 1997	Date of mailing of the international search report 29.01.1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Michel Gascoin Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 96/00629

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5422674 A (D.F. HOOPER ET AL), 6 June 1995 (06.06.95), abstract --	1-9
E,A	WO 9638008 A1 (THOMSON CONSUMER ELECTRONICS, INC.), 28 November 1996 (28.11.96), abstract -- ---------	1-9

INTERNATIONAL SEARCH REPORT
Information on patent family members

28/10/96

International application No.
PCT/IB 96/00629

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5089899	18/02/92	JP-B- 2531795	04/09/96
		JP-A- 3032288	12/02/91
EP-A2- 0624979	17/11/94	BE-A- 1007167	11/04/95
		JP-A- 7046474	14/02/95
US-A- 5422674	06/06/95	EP-A- 0660609	28/06/95
		US-A- 5493638	20/02/96
WO-A1- 9638008	28/11/96	GB-D- 9510507	00/00/00

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EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 07170510
PUBLICATION DATE : 04-07-95

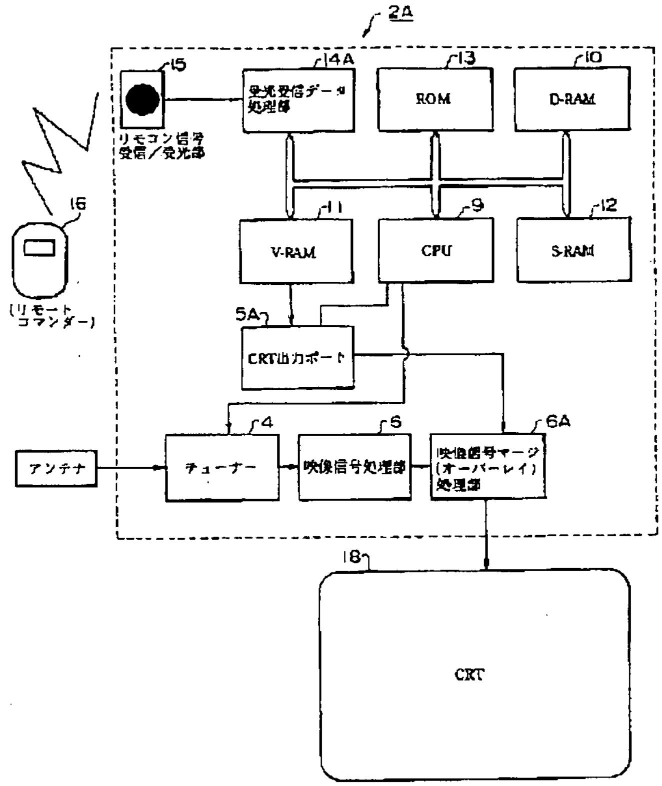
APPLICATION DATE : 14-12-93
APPLICATION NUMBER : 05313351

APPLICANT : SONY CORP;

INVENTOR : YOSHINOBU HITOSHI;

INT.CL. : H04N 7/16

TITLE : CHANNEL LOCK SYSTEM FOR BROADCAST



ABSTRACT : PURPOSE: To provide versatile functions to a pay broadcast by including a signal controlling a lock means of a receiver receiving the broadcast to a broadcast signal of plural channels to be sent so as to limit a video signal and an audio signal of a specific channel.

CONSTITUTION: An output of a video signal processing section 6 of each receiver 2A is processed by a video signal merge processing section 6A based on an ID number for non-contract party and nonpayment party or the like included in a broadcast signal of plural channels of a pay broadcast station. A CPU 9 executes a program stored in a ROM 13 to control the entire receiver 2A and checks the presence of registration of a screen saver based on an ID number of a fixed scramble system broadcast signal. When the saver is registered, the processing section 6A allows a display section 18 to properly display a specific screen saver for each channel received by the CPU 9 so as to make viewing of video and audio unable or partly enable in the specific broadcast signal. Thus, diversified functions are enhanced for a program and a time of a pay broadcast.

XP 000581420

8195 FKT Fernseh-und Kino-Technik
50(1996) Mar[illegible]o. 3, Heidelberg, DE

E
p.110-114=(5)

U. SCHMIDT, FKTG

Der „Medienmanager", eine neuartige Benutzerführung für Multimedia-PCs

Bei multimedialen PCs ist es mit der Integration von Einzelkomponenten nicht getan. Vielmehr muß die Funktionsvielfalt der Geräte so dargeboten werden, daß der Benutzer stets die Übersicht behält. Dieser Beitrag stellt unter der Bezeichnung 'Medienmanager' eine neuartige Benutzerführung vor. Sie ermöglicht die multimedialen Grundfunktionen Fernsehen, Abspielen von Video-, Photo- oder Audio-CDs, Radiohören, Telefonieren und im Videotext blättern auf intuitiv erfaßbare Art und Weise. Dabei muß sich der Benutzer nicht mit den Eigenheiten des PC-Betriebssystems belasten.

Dr.-Ing. Ulrich Schmidt ist Leiter der Entwicklung bei der miro Computer Products AG in Braunschweig

1. Einleitung

Die Mikroprozessortechnik hat seit ihrer Erfindung vor fünfundzwanzig Jahren unsere gesamte Infrastruktur durchdrungen und von innen heraus neu gestaltet. Selbst die alltäglichsten Dinge — von der Armbanduhr bis zum Eierkocher — werden heute von Mikroprozessoren gesteuert.

Die ständig fortschreitende und auch heute noch anhaltende Miniaturisierung in der Mikroelektronik hatte neben der Erhöhung der Rechenleistung auch eine Demokratisierung der Rechentechnik zur Folge. Zum ersten Mal war es praktisch allen Bevölkerungskreisen möglich, einen Rechner zum eigenen Gebrauch zu erwerben: Der Personal Computer war geboren.

Sofort erhob sich die Frage, was denn ein Privatmensch mit einem derartigen Gerät anfangen solle. Die so fragten, verkannten, daß in der Technikgeschichte die Dinge nicht von oben, sondern von unten getrieben werden. Es ist schon erstaunlich, gegen welche Widerstände und Auflagen sich so grundlegende Erfindungen wie das Automobil, das Telefon oder das Flugzeug durchsetzen mußten. So erließ das britische Parlament in den Anfangsjahren der Motorisierung ein Gesetz, nach dem jedem Automobil ein Fußgänger mit einer Fahne voranzugehen hatte — zwecks Warnung der ländlichen Bevölkerung. Heute amüsieren wir uns darüber. Vielleicht werden sich spätere Generationen einmal genauso über den Versuch des Staates amüsieren, mit Hilfe von Landesmedienanstalten und Technikfolgenabschätzungskommissionen die technische Entwicklung zu steuern und zu lenken.

Im Falle des Personal Computers zeigte sich eine ähnliche Entwicklung wie zuvor schon beim Telefon: Die massenweise Verbreitung der Geräte hatte auch ein Demokratisierung der Inhalte zur Folge. So wurde das Telefon keineswegs, wie es Alexander Graham Bell vorschwebte, zur öffentlichen Fernübertragung von Opernaufführungen verwendet. Vielmehr diente es zum Austausch meist belangloser Nachrichten, die man ebensogut per Brief hätte übermitteln können. Und auch der PC wurde nicht zum Lösen von Differentialgleichungen verwendet, sondern als Spielgerät und als Schreibmaschine, in Anwendungen also, für die es bereits Lösungen gab. Der Erfolg von Telefon und PC beruht demnach nicht auf völlig neuen Anwendungen, sondern auf Verbesserungen bereits bestehender Lösungen: Schnelligkeit in der Kommunikation (das erklärt auch den Erfolg von Fax und e-mail) oder für 'Textkorrektur ohne Tränen'. Dafür wurden sogar eindeutige technische Nachteile in Kauf genommen wie die Bandbreitenbegrenzung beim Telefon oder das typische Computerschriftbild der frühen Matrixdrucker.

Derzeit unternimmt ein neues Gerätekonzept seine ersten Gehversuche: der Multimedia-PC. Kritiker wenden ein, das Gerätekonzept sei gar nicht neu, viel-

mehr handele es sich nur um eine Zusammenfassung bereits bekannter Komponenten, die es zudem einzeln besser und billiger gebe. Der Einwand ist richtig, aber er trifft nicht das Wesentliche. Denn neben der Integration von Elementen der Unterhaltungselektronik bietet der Multimedia-PC die für jeden PC typischen Merkmale:

- Er verfügt über Massenspeicher (Festplatte, CD-ROM-Laufwerk).
- Der PC bietet hochauflösende Graphik.
- Der PC ist kommunikationsfähig (Analog-Modem, ISDN-Schnittstelle).
- Der PC hat eine offene Architektur, in Hardware (Bus) wie in Software (Betriebssystem mit Schnittstellen für Anwendungsprogramme).

Das Neuartige an den Multimedia-PCs ist die Verbindung dieser Elemente mit eher traditionellen Inhalten:

- Massenspeicher halten bisher flüchtige Inhalte (Bild, Ton, Videotext) fest und können im Verein mit entsprechender Software wie Datenbanken genutzt werden.
- Hochauflösende Graphik ermöglicht die Gestaltung ästhetisch ansprechender Benutzeroberflächen.
- Die Kommunikationsfähigkeit in Form eines eingebauten Rückkanals ist Voraussetzung für interaktive Anwendungen.
- Die standardisierte, offene Hardware- und Software-Architektur erlaubt einer Vielzahl von Herstellern, als Lösungsanbieter aufzutreten; das beschleunigt die Marktentwicklung erheblich.

Es ist allerdings nicht zu übersehen, daß der Multimedia-PC im gegenwärtigen Stadium einer Maschine im Rohzustand gleicht. Die vielen inhärenten Möglichkeiten werden durch die gängigen Betriebssysteme und deren Benutzeroberflächen nur unzureichend zugänglich gemacht. So verwenden diese Benutzeroberflächen Metaphern, die der Arbeitswelt entlehnt sind (Büro, Schreibtisch). Auch sind sie auf ein Maximum an Ausdrucksmöglichkeiten ausgelegt. Dabei laufen im Prinzip beliebig viele, gleichzeitig aktive Prozesse ab. Moderne Betriebssysteme öffnen dabei eine entsprechende Anzahl sich gegenseitig überlappender 'Fenster' oder sie repräsentierender 'Icons'.

Diese Ausdrucksvielfalt erfreut das Herz des Programmierers, so wie das Cockpit eines älteren Flugzeugs den Flugingenieur. Aber ebenso wie hunderte von Anzeigen und Steuermöglichkeiten des Cockpits einem 'aufgeräumten' Design weichen mußten, so muß heute die Komplexität eines Multimedia-PCs soweit reduziert werden, daß auch Nicht-Programmierern der Umgang mit ihm leichtfällt. Wer weiß, vielleicht geht auch der Programmierer irgendwann einmal den Weg des Flugingenieurs...

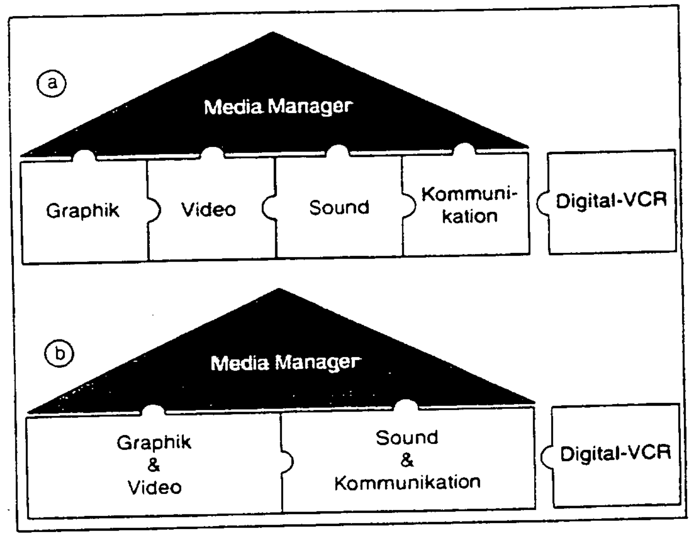


Bild 1. Das multimediale Haus.
a) in Komponentenbauweise (4 Slots,
b) in Kompaktbauweise (2 Slots)

2. Das multimediale Haus

Bei multimedialen PCs ist es mit der Integration von Einzelkomponenten nicht getan; der Funktionsreichtum des Geräts muß vielmehr so dargeboten werden, daß der Benutzer stets die Übersicht behält. Zu diesem Zweck hat **miro** unter der Bezeichnung 'Medienmanager' eine neuartige Benutzerführung entwickelt, die die multimedialen Grundfunktionen

— Fernsehen,
— Video-, Photo- oder Audio-CD abspielen,
— Radio hören,
— Telefonieren und
— im Videotext blättern

auf anschauliche und konsistente Art und Weise zugänglich macht. Der Benutzer bleibt dabei von den Eigenheiten des PC-Betriebssystems unbelastet. Außerordentlich hilfreich war dabei die Tatsache, daß die Hardware in Form von Steckkarten für Graphik, Video, Sound und Kommunikation ebenfalls von miro selbst entwickelt wurde. Es gibt nämlich gerade für die fortgeschrittenen Multimedia-Funktionen wie Fernsehen, Radio und Videotext zur Zeit noch keine verbindlichen Standardschnittstellen. Dieses Manko ist um so schwerwiegender, als der PC im Gegensatz zum Fernseher eigentlich nicht für die Echtzeitverarbeitung kontinuierlicher Bild- und Tonsignale ausgelegt ist. Ruckelnde Bilder voller Bewegungs- und Quantisierungsartefakte sind für leidgeprüfte PC-Besitzer nichts Unbekanntes. Erst die gleichzeitige Entwicklung von Multimedia-Hardware und -Software macht die Umgehung solcher PC-bedingten Einschränkungen möglich.

Das Ergebnis dieser Entwicklung ist eine Architektur, die man als 'multimediales Haus' bezeichnen kann. Bei diesem Haus ruht das alles überspannende Software-Dach auf dem Fundament der vier Hardware-Funktionen Graphik, Video, Sound und Kommunikation. Diese Funktionen sind physisch als Steckkarten ausgeführt, entweder als vier Einzelkomponenten **(Bild 1a)** oder als zwei Kompaktkomponenten **(Bild 1b)**. Letztere integrieren auf zwei Steckkarten die Funktionen

- Graphikprozessor + MPEG1-Decoder + Fernsehtuner + Videodecoder + Stereodecoder + Videotext-decoder + Videocoder (Ausgabe von Graphik und Video auf dem Fernseher) *(miroMEDIA View TV)*
- Sprachfähiges Hochgeschwindigkeitsmodem (28.800 bit/s) + Wavetable-Synthese + UKW-Radio + RDS-Decoder *(miroCONNECT RDSradio)*

Als optionaler 'Anbau' am multimedialen Haus kommt noch die *miroVIDEO DC20* in Betracht, eine Motion-JPEG-Karte, die normalerweise für die Videonachbearbeitung eingesetzt wird. Hier wird sie

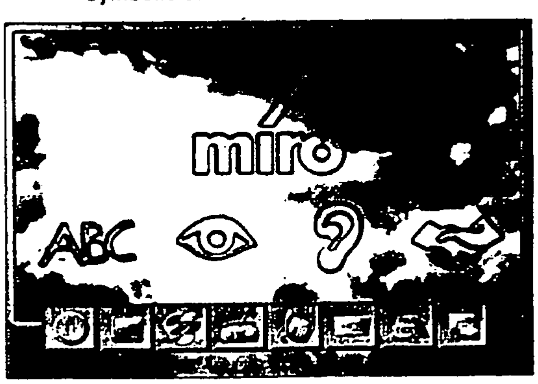
Bild 2. Fernbedienung des Medienmanagers

aber in Verbindung mit einer großen Festplatte als 'digitaler Videorecorder' genutzt. Alle Karten sind wie Teile eines Puzzles untereinander und mit dem Software-Dach verzahnt, im übertragenen Sinn als funktionale Komponenten einer Gesamtarchitektur wie auch im wörtlichen Sinn: Eine kartenübergreifende Verkabelung von Nutz- und Steuersignalen sorgt dafür, daß alle internen und externen Bild- und Tonquellen ihre Daten an alle angeschlossenen Senken schicken können. Der PC-Bus allein vermag das leider nicht zu leisten.

3. Design des Medienmanagers

Das multimediale Haus präsentiert sich dem Anwender in der Aufsicht. Das Dach, also der Medienmanager, ist gleichzeitig die Benutzerschnittstelle. Jede Benutzerschnittstelle hat einen funktionalen und einen ästhetischen Aspekt: Alles im System geschieht über sie, und gleichzeitig erscheint sie als das System selbst. Der Entwurf einer solchen Schnittstelle ist also von zentraler Bedeutung; der Grad ihrer Akzeptanz entscheidet letztlich über Gelingen oder Mißlingen eines Multimedia-Konzepts.

Bild 3. Grundbild des Medienmanagers mit Symbolleiste



Zur Lösung dieser Aufgabe ist miro an die Hochschule für Bildende Künste in Braunschweig herangetreten. Prof. van den Boom und seine Mitarbeiter vom Lehrstuhl für Visualisierungsforschung haben sich dankenswerterweise dieser Herausforderung gestellt und in der Folge den Medienmanager entworfen. Im Rahmen dieses Beitrags kann nur das Ergebnis vorgestellt und diskutiert werden, für die dahinterliegende interessante 'Theorie des Studios als Informationsumgebung' sei der Leser auf die Darstellung in [1] verwiesen.

Ziel des Designs war, eine in der Anwendung intuitiv erfaßbare, in der Symbolik konsistente und in der Gestaltung attraktive Benutzerschnittstelle zu schaffen. Insbesondere sollte das Design konsequent durchgestaltet sein und nicht in vordergründigen Effekten steckenbleiben. Das aus diesen Vorgaben entstandene Erscheinungsbild des Medienmanagers orientiert sich nicht an einer gegenständlichen Metapher wie beispielsweise Schreibtisch oder Wohnzimmer, sondern verwendet eine abstrakt-geometrische Formensprache von zeitloser Klarheit.

Hinsichtlich seiner Funktionalität erscheint der Medienmanager auf zweierlei Weise:

— Die 'einfache' Welt ist gekennzeichnet durch vollständige Nutzung des Bildraums durch die Videosignale. Außerdem tritt kein Betriebssystem mit der üblichen Fensterwelt nach außen. Die Steuerung erfolgt per Fernbedienung.
— Die 'professionelle' Welt ist gekennzeichnet durch die Einbettung der Multimedia-Funktionen in die normale Betriebssystemumgebung. Die Steuerung erfolgt per Maus und Tastatur.

Damit soll zwei typischen Anwendungsszenarien bei Multimedia-PCs Rechnung getragen werden: der ausschließlichen Multimedia-Nutzung in 'entspannter' Haltung und der teilweisen Multimedia-Nutzung während des 'ernsthaften' Arbeitens mit dem PC. Für die erstgenannte Anwendung werden eine eigene Fernbedienung (**Bild 2**) sowie ein entsprechender Infrarotempfänger mitgeliefert.

4. Umgang mit dem Medienmanager

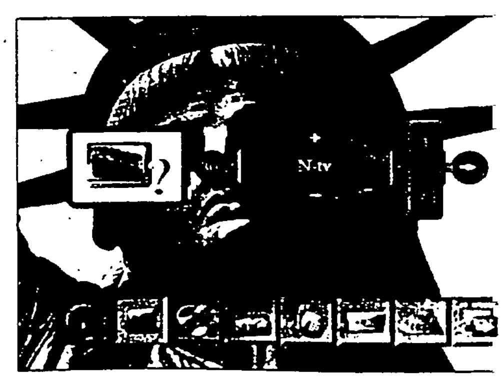
Nach Aufruf des Medienmanagers treten dem Benutzer die implementierten Multimedia-Funktionen als eine Reihe großflächiger, stilisierter Symbole gegenüber (**Bild 3**). Diese Symbole stehen von links nach rechts für

— Ein-/Ausschalten des Medienmanagers,
— Fernsehen,
— Video-, Photo- und Audio-CD,
— Radio mit RDS-Funktion,
— Telefon,
— Recorder,
— Videotext und
— Wechsel in die professionelle Welt.

Diese Symbole können ausgewählt und aktiviert beziehungsweise deaktiviert werden. Zur Auswahl überstreicht man die Symbole durch eine Horizontalbewegung der Maus oder betätigt die Links-/Rechts-Tasten der Fernbedienung. Hierdurch bewegt sich ein roter Rahmen sprungweise von einem Symbolfeld zum nächsten. Das ist auch aus einiger Entfernung noch gut zu erkennen und erübrigt eine punktgenaue Cursor-Plazierung. Maus und Fernbedienung können übrigens ohne Umstöpseln wahlweise benutzt werden. Dazu sind Maus und Infrarotempfänger über ein gemeinsames Kabel an den seriellen Eingang des PC angeschlossen. Ein spezieller Maustreiber erkennt zudem, von welchem Eingabegerät der jeweilige Befehl stammt.

Das durch den roten Rahmen ausgewählte Symbol kann nun durch Mausklick oder die „ok"-Taste der Fernbedienung aktiviert werden. Als optische Quittung wechselt die Farbe des Symbols von blau nach gold. Gleichzeitig erscheinen die zum aktivierten Gerät gehörenden Bild- und/oder Tonsignale sowie ein

Bild 4. Fernsehen mit dem Medienmanager



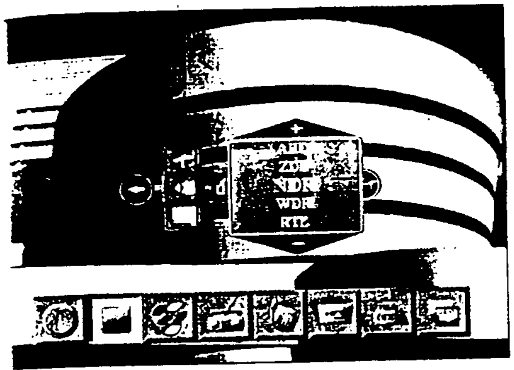


Bild 5. Fernsehbild mit Steueraktor, Rückverweisknopf und weiteren Einstellhilfen

als 'Steueraktor' bezeichnetes graphisches Steuerelement. Im **Bild 4** ist der Fernsehsteueraktor dargestellt. Von links nach rechts erkennt man

— den Multifunktionsrahmen (äußerst linkes Rechteck), der Begleitinformationen zur Sendung enthalten kann, beispielsweise den Titel der laufenden Sendung.

— den Aufnahmeknopf (Kugel mit eingeprägtem „Rec"). Wird er betätigt, so wird die laufende Sendung auf der Festplatte aufgezeichnet. Der Vorgang wird beendet, sobald die Platte voll ist oder der Knopf ein zweites Mal gedrückt wurde. Befindet sich eine Kompressionskarte wie die *miroVIDEO DC20* im PC, dann kann die Sendung mit voller Bildrate und in S-VHS-Qualität aufgezeichnet werden. Andernfalls wird ein Software-Coder benutzt, der mit zeitlicher und räumlicher Unterabtastung arbeitet. Für jede Aufzeichnung wird vom Medienmanager automatisch ein neuer Dateiname vergeben, ohne daß sich der Benutzer darum kümmern muß. Abgespielt werden kann die Aufzeichnung

Bild 7. Bedienoberfläche zum Abspielen einer Video-CD

später durch Aktivierung des Recorder-Symbols auf der Symbolleiste.

— Die Programmplatzwahl erfolgt im breiten Rechteck mit oben und unten angefügten Dreiecken. Durch Betätigen der Oben-/Unten-Tasten der Fernbedienung oder durch Anklicken der Plus- und Minusfelder werden die Programme ausgewählt.

— Die Lautstärkeeinstellung ist im schmalen Rechteck mit eingelassenem Dreieck zu erkennen. Durch Betätigung der Oben-/Unten-Tasten der Fernbedienung erhöht oder reduziert man die Lautstärke. Als optisches Analogon wächst oder schrumpft das rote Lautstärkedreieck innerhalb seines rechteckigen Rahmens.

— Die äußerst rechte Kugel mit eingeprägtem Pfeil stellt den Verweisknopf auf weitere Funktionen dar. Wird er betätigt, wird eine Ergänzung des Steueraktors mit seltener verwendeten Funktionen aufgerufen.

Der Steueraktor ist so konzipiert, daß alle wichtigen Funktionen des gewählten Geräts auch aus einiger Entfernung auf einen Blick erfaßbar und mit einer Bewegung erreichbar sind. Für Benutzer, die das Bild nicht durch darüberliegende graphische Symbole verdecken wollen, besteht die Möglichkeit des Direktzugangs zu den häufigsten Funktionen. Auf der Fernbedienung (s. Bild 2) befinden sich neben den vier Richtungstasten die Tastenpaare

— Program up/down sowie

— Volume up/down.

Außerdem kann durch die separate Stummschalttaste der Ton jederzeit ab- und wieder angeschaltet werden.

Komplexere Funktionen, die in der Regel selten benutzt werden, lassen sich über den Verweisknopf erreichen. Im Falle des Fernsehers erscheint dann der Steueraktor, wie im **Bild 5** gezeigt. Ganz links befindet sich der

— Rückverweisknopf. Diese Kugel mit eingeprägtem Pfeil wechselt nach Betätigung wieder in sein normales Erscheinungsbild.

— Daneben ist das Feld zur Tuner-, Ton- und Bildeinstellung. In einem schmalen Rechteck befinden sich die Symbole für Antenne, Ton und Bild.

— Bei Anwahl des Antennensymbols öffnet sich am rechten Ende des Aktors e[illegible] Feld mit Sendernamen. Die ange[illegible]en Halbkugeln ('Ohren') diene[illegible] Aktivierung eines automa-

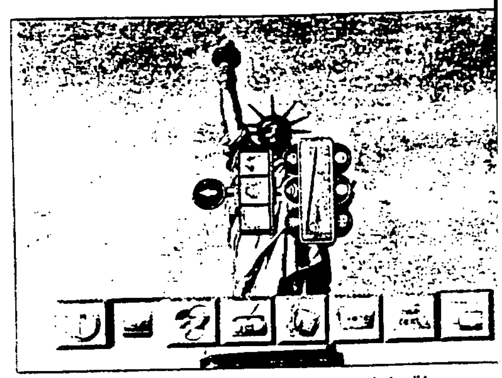


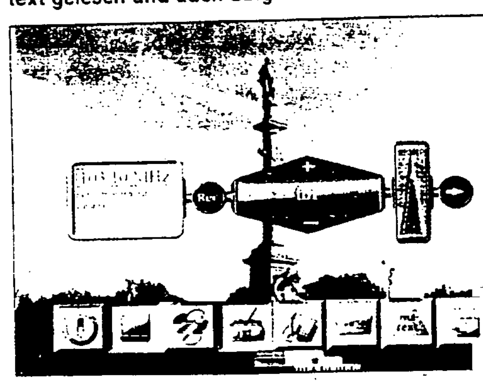
Bild 6. Die Bildfunktionen lassen sich über den Fernsehaktor einstellen

tischen Sendersuchlaufs oder zum Löschen eines Programmplatzes. Die Sendernamen werden dem VPS-Signal entnommen. Außerdem lassen sich die Sendernamen durch Direkteingabe innerhalb des Feldes jederzeit umbenennen. Die gefundenen Sender können nach verschiedenen Gruppen, unter anderem Sport oder Kultur, geordnet und später wieder aufgerufen werden.

Bild 6 zeigt das Erscheinungsbild des Fernsehaktors für die Einstellung der Bildfunktionen. In diesem Fall stehen die angesetzten Ohren für die Funktionen Farbsättigung, Kontrast, Lautstärke, Farbton, Helligkeit und Normalwerteinstellung. Nach Anwahl des entsprechenden Ohres kann mit dem Dreieck der jeweilige Funktionswert erhöht oder reduziert werden.

Im **Bild 7** ist das Abspielen einer Video-CD dargestellt. In diesem Fall enthält der Multifunktionsrahmen Angaben zu Titel und Spielzeit. Das rautenförmige Symbol auf der Aktorstange enthält in der Horizontalen die Laufwerksfunktionen Rücklauf, Pause, Vorlauf und in der

Bild 8. In der Radiofunktion kann der Radiotext gelesen und auch aufgezeichnet werden



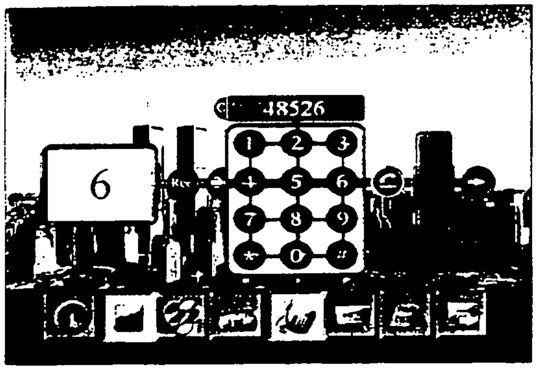


Bild 9. Telefonieren und Fernsehen zur gleichen Zeit

Vertikalen den Sprung zum nächsten (+) oder vorherigen (–) Titel. Der Knopf mit dem eingeprägten Rechteck steht für die Stopfunktion.

Bild 8 zeigt die Nutzung des Radios. Der Aufbau des Radioaktors ähnelt dem des Fernsehaktors, allerdings findet sich im Multifunktionsrahmen der im RDS-Signal ausgestrahlte Radiotext. An der Symbolleiste erkennt man übrigens, daß zur Zeit sowohl der Fernseher als auch das Radio aktiviert sind. In diesem Fall sind ein Bild- und zwei Tonsignale aktiv. Durchgeschaltet wird jeweils das Signal des angewählten Geräts. Es reicht eine Links-/Rechtsbewegung aus, um beispielsweise zwischen Fernseh- und Radioton hin- und herzuwechseln. Ein weiteres Beispiel wäre die gleichzeitige Aktivierung von Fernseher und Video-CD. In diesem Fall würden durch die Anwahl des Geräts Bild und Ton umgeschaltet. Selbstverständlich können auch mehr als zwei Geräte gleichzeitig aktiv sein. Ein Überstreichen der Symbolleiste von links nach rechts würde dann nacheinander Fernsehton, CD-Ton, Radioton und Telefonton auf die Lautsprecher schalten. Jedes angewählte Bild und jeder angewählte Ton kann mittels des Aufzeichnungsknopfes spontan auf der Festplatte aufgezeichnet werden. Es ist eben dieser spielerisch leichte Wechsel zwischen den verschiedenen Multimedia-Funktionen, der die Komplexität moderner Multimedia-Endgeräte auch für den ungeübten Benutzer beherrschbar macht.

Im **Bild 9** telefoniert jemand, während im Hintergrund das Fernsehbild weiterläuft. Die Telefonnummer kann entweder aus einer vorher angelegten Liste oder durch Eingabe per Zehnertastatur gewählt werden. Die Betätigung des Knopfes mit dem Telefonhörer startet den Wählvorgang und beendet auch wieder das Gespräch. Verwendet wird entweder die mitgelieferte Freisprecheinrichtung der *miroCONNECT RDSradio* oder ein angeschlossener Handapparat.

Bild 10 schließlich zeigt die Nutzung des Videotextes. Er wird in einem mehrstufigen Verfahren (Kartenspeicher, Hauptspeicher, Festplatte) so abgespeichert, daß die gewünschten Seiten praktisch sofort zur Verfügung stehen. Bei Nichtnutzung des Fernsehtuners werden automatisch Seiten im Hintergrund geladen oder wieder aktualisiert. Innerhalb einer Videotextseite kann durch Anwahl einer Seitennummer zu dieser Seite verzweigt werden.

Im **Bild 11** ist die Symbiose von Medienmanager und 'ernsthafter' Anwendung dargestellt, wie sie sich nach Betätigen des Verweisknopfes auf der Symbolleiste darstellt. Über einem Textverarbeitungsprogramm, das wie gewohnt genutzt wird, liegen eine verkleinerte Ausgabe von Symbolleiste und Fernsehbild; der Ton läuft im Hintergrund weiter. Bild und Leiste lassen sich 'anfassen' und mit der Maus verschieben. Dies ermöglicht ein Weiterarbeiten mit dem PC bei gleichzeitiger — wenn auch eingeschränkter — Nutzung des Multimedia-Angebots. Ein Wechsel in die 'einfache' Welt mit der vollen Nutzung des Bildschirms für das Fernsehsignal ist jederzeit durch nochmalige Betätigung des Verweisknopfes möglich.

5. Ausblick

Die umfassende Darstellung einer multimedialen Anwendung, wie sie der Medienmanager bietet, ist hier nur eingeschränkt möglich. Es fehlt die so wesentliche Zeitkomponente, die aus einer Aneinanderreihung statischer Situationsbeschreibungen erst eine als mühelose Ganzheit erlebte dynamische Anwendung macht. Das Gefühl der Mühelosigkeit wird freilich erst dann erreicht, wenn gewisse aus der Psychologie bekannte Zeitschwellen nicht überschritten werden. Der Umgang mit einem Multimedia-PC wird erst dann als angenehm empfunden, wenn man niemals zum Warten gezwungen ist. Diese wichtige Voraussetzung berücksichtigt der Medienmanager durch ein Konzept des minimalen Aufwands bei Wahl und Wechsel der Funktionen sowie durch das Zulassen beliebig vieler, gleichzeitig aktiver Bild-, Ton- und Textquellen.

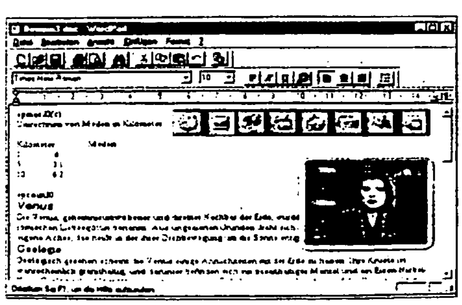


Bild 11. Symbiose von Medienmanager und professioneller Nutzung

Bild 10. Auch Videotext-Nutzung läßt sich vereinfachen — und zugleich beschleunigen

Der Medienmanager ist in Funktion und Erscheinung auf Erweiterung angelegt. Als Dach des Multimedia-Hauses wird er in Zukunft weitere Funktionen integrieren, beispielsweise Sat-TV, DVB, DVD oder Internet. Innerhalb der Steueraktoren können weitere Einstellmöglichkeiten untergebracht werden. Beide Erweiterungsmöglichkeiten finden ihre visuelle Entsprechung im Reihungsprinzip, als Erweiterung der Symbolleiste oder der Aktorstange. Die funktionale und klar gegliederte graphische Symbolik sowie die Fernbedienung wurden speziell für diesen Zweck entworfen. Sie ermöglichen einen spielerisch leichten, aber nicht vordergründig-selbstzweckhaften Umgang mit dem Multimedia-PC. Ob sich aus dem heutigen Multimedia-PC einmal eine ganz eigenständige Gerätegattung herausbilden wird, kann allerdings erst die Zukunft zeigen: hoffnungsvolle Ansätze dafür gibt es.

Schrifttum

[1] van den Boom, H.: Betrifft: Design. Unterwegs zur Designwissenschaft in fünf Gedankengängen. VDG Verlag und Datenbank für Geisteswissenschaften. Alfter, 1994, ISBN 3-929742-30-6.

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COLOR TABLE ANIMATION

Richard G. Shoup

Xerox Palo Alto Research Center
Palo Alto, CA

ABSTRACT

Even a small amount of animation can greatly enhance graphic communication -- particularly when it is desired to show change, movement, or a complex idea or relationship. In raster scan display systems, however, the cost of providing animation has usually been prohibitively high due to the large bandwidths involved in changing a picture rapidly. This paper decribes a simple method for providing a limited but very useful real-time interactive animation capability on many existing frame buffer systems. Color table animation relies on changing only the colors of objects and areas present within a single, static picture via the frame buffer's color table RAM. Several variations of this technique are discussed and examples are given of such a capability in use for illustration, educational animation, and television graphics.

Key words and phrases: computer animation, color table, raster scan, frame buffer, computer graphics.

CR Categories: 8.2, 3.41, 3.11.

INTRODUCTION

The value of dynamics in visual communication is great. It is said that a picture is worth a thousand words (more than *ten* thousand, according to the old Chinese proverb), and a picture which moves is often worth at least a thousand static pictures. Despite recent technological advances and reductions in the cost of digital hardware, animation is still prohibitively expensive or impossible in most raster scan display systems. For systems where significant animation is required, off-line or non-real-time generation of the images is often necessary. While these approaches can be completely general, they lack the powerful capability of interactively editing and manipulating the animation as it is being created.

Direct updating of a frame buffer image generally requires a large amount of bandwidth. A typical frame buffer picture is represented by over 2 Mbits of pixel data (480 x 640 x 8 bits/pixel, for example) which must be updated at a rate of at least 10 frames per second for reasonably smooth animation. Thus at least 20 Mbits/sec must be transferred more or less continuously in order to provide animation by this direct update approach. Very few frame buffer systems can support such a data rate from CPU to frame buffer, no less from disk or other secondary storage.

There are several ways in which dynamics and animation have been achieved in raster scan display systems:

1. The picture can be computed on-the-fly from a higher-level data structure. Using real-time hardware and perhaps also double-buffering of the image, new frames are continuously scan-converted from the object data structure. This general approach has been used extensively, for example, in visual flight simulators where the data structure consists of polygons in 3-space[1]. While a certain degree of real-time interaction is hereby provided, this type of system requires large computing power obtained via special-purpose hardware and is consequently very expensive by comparison to a static display of the same data base.

2. Various methods can be employed to reduce the real-time picture update bandwidth to the range which can be supplied from secondary storage[2]. Such methods include run-length or other encoding of pixel data, reduced resolution, updating only changed elements, structured overlays, etc. Thus a representation which is close to the final picture data can be computed, stored on disk and later played back in real-time. This approach usually requires a high-performance disk memory and a small amount of special-purpose hardware. More important, non-real-time picture generation severely limits the interaction possible during creation of the animation and therefore requires much greater predictive skills on the part of the user (just as in conventional cel animation). A separate outline or "pencil test" capability[3] may also be provided which permits previewing in real time.

3. A frame-at-a-time recording device such as a video disk or film camera can be used to record the already-computed or assembled frames at a rate less than real-time and later play them back at full speed[4,5]. This recording device is often expensive compared to the computing and display hardware itself. Again the interactive possibilities are very limited.

4. Another real-time approach has been implemented in a personal computer[5] where the images are composed of overlaid bit-maps, albeit in black/white (1 bit/pixel) and at fairly low resolution (256 x 256) and update rate (3-10 frames/sec). In this case, the hand-drawn bit-map

images resident in main memory are assembled (overlaid in a manner analogous to an animator's cels) via fast CPU microcode. This system does permit the user to interact with the ongoing animation -- an extremely valuable capability when creating an animation or when the system is used directly in a teaching situation, for example.

The display CRT in this system is refreshed directly out of main memory instead of from a separate frame buffer memory. Thus the picture data can be addressed and manipulated directly by the CPU. However, this approach requires that the memory capacity and the bandwidth necessary to drive the display be available from main memory in addition to that normally needed for computation. This is reasonable in the present system, since the image being displayed requires only 4K 16-bit words and a peak bandwidth of ~10 Mbit/sec. However, a full 2-Mbit frame buffer would require an additional 128K 16-bit words of main memory and a peak bandwidth of 96 Mbit/sec. The tradeoff here is between a display which is limited by the bandwidth and size of a memory built to CPU requirements, and a main memory with significantly greater bandwidth and size (and cost) than is appropriate to the CPU alone. In general, the requirements of general-purpose computing and those of image processing and display are quite disparate.

5. In a somewhat different vein, Computer Image Corporation has used highly-interactive *analog* computer animation systems for over 10 years in the production of television graphics and animation[7]. The disadvantages of the analog scan conversion approach are strongly offset by the ability to perform motion, scale change and deformations interactively in real time.

Fortunately, even motion which is graphically very simple can produce a vastly more effective visual communication than a still image. In short, *a little animation goes a long way*. If we are willing to forego full Disney-style animation and strongly limit the content and dynamics of our images, then much simpler, highly interactive solutions can be found. Also fortunately, flat-color 2-D cartoon-like animation is quite an adequate and familiar medium for many graphical communications such as illustrations, diagrams, charts, presentation aids, etc. and in education, television graphics and advertising.

COLOR TABLE ANIMATION

Color table animation simply relies on changing only the *colors* of objects and areas present within a *single, static* picture by using the frame buffer's color table RAM. This idea has been independently implemented on various frame buffer systems with attractive results[8,9]. Although the animation effects which are possible are somewhat limited, a little ingenuity on the part of the artist results in a suprisingly rich variety of visual expression. A good user interface and a considerable period of first-hand experimentation are necessary, in fact, to fully appreciate the possibilities.

Color table RAMs have been available on various frame buffer systems for some time[10,11,12]. Color tables are frequently used to provide gamma correction or other compensation or to create a pseudo-color display of monochrome data. Figure 1 shows a typical frame buffer system with a color table. Numbers stored in the frame buffer memory at each pixel can be thought of as representing virtual color *names* in a manner analogous to a virtual address space. For example, if the frame buffer stores 8 bits/pixel, then 256 independent virtual colors may appear within the picture. The color table consists of 256 words, each containing the values of the red, green, and blue components corresponding to one pixel value (color name). During scanning, each pixel value is read from memory and is used to address the color table RAM. The resulting primary component values are then passed to the D/A converters.

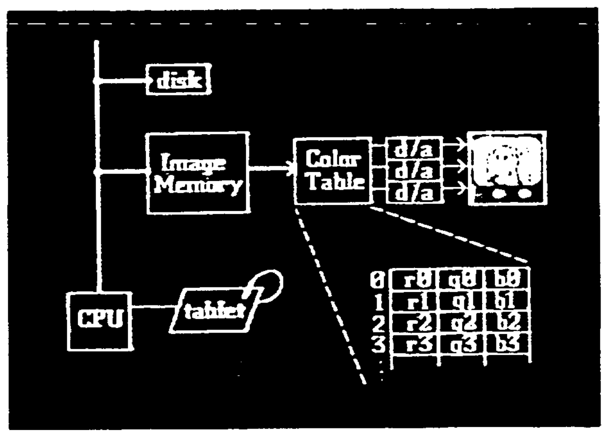

Figure 1. Frame buffer with color table.

Usually, the color table RAM can be updated quickly (a few μsec per word) under program control from the CPU. Thus most or all of the virtual color space can be changed in a short time such as during the display's vertical blanking interval (~1.3 msec in the case of conventional 525-line television). If 10 μsec are required to change a word in the table, for example, then all 256 color definitions can be changed in two vertical interval times, e. g. at full frame rate. Usually, a slower rate is desired and the effective speed of the animation can be controlled by simply updating the color table less frequently.

SIMPLE CASES

The simplest case of color table animation is *color cycling*. In this case, every color definition in the color table is simply shifted by one pixel value (one address) in a cyclic fashion. Color cycling produces an effect similar to the animated signs often seen in store showroom displays utilizing a light, a spinning polarizer disk and colored cellophanes. This effect can be used to create smooth fluid flow (Figure 2a) or discrete stepping motion of many objects simultaneously (Figure 2b).

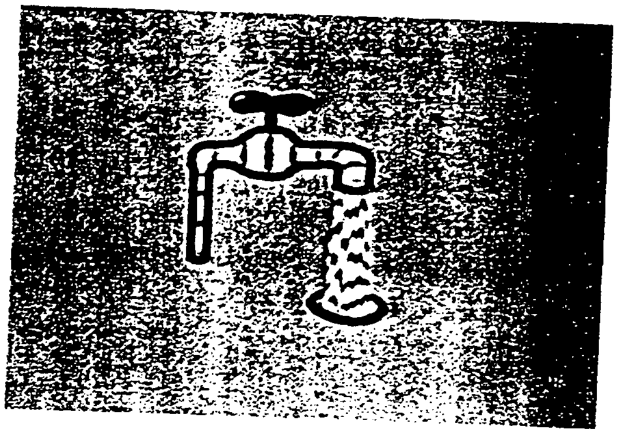

Figure 2a. Cycling animation - hot water faucet.

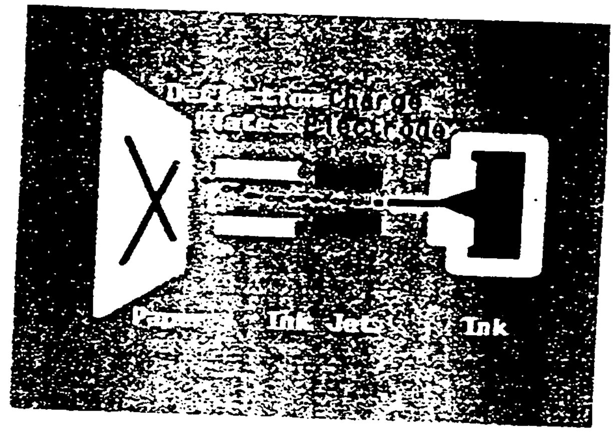

Figure 2b. Cycling animation - ink jet printer.

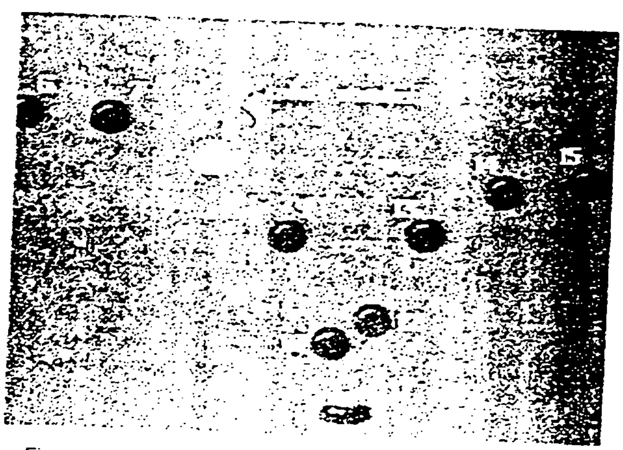

Figure 3a. Alternate-color animation - bouncing ball.

Figure 3b. Alternate-color animation with several independent motions - autumn.

A more interesting variation is *alternate-color animation*. Several positions of an object are present in the picture, each in a different color number (pixel value). Initially all color definitions are set equal to the background color so that all the positions of the object are effectively invisible. The animated effect is then created by changing color definitions one at a time from background to foreground color so as to reveal the hidden objects in sequence. See Figures 3a and 3b. Notice that successive images can be different in shape and size so that much more than just a simple translating motion is possible. Furthermore, several objects or areas can be in apparent motion simultaneously. This technique can also be used to sequentially reveal parts of an illustration or diagram (like the block diagram in Figure 1, for example) as the speaker refers to them.

By providing an entire set of background and foreground colors, objects can be made to move over a multi-colored background so long as each object position has only one color of background "behind" it. This means that it is difficult to move an object over a textured or highly detailed background. The most serious restriction in this type of animation, however, is that successive positions of the object(s) must be disjoint and cannot overlap or intersect one another. The number of steps in the animation is, of course, limited in all these cases by the available number of possible pixel values. All examples shown here were created in a 4-bit/pixel frame buffer and utilize ten steps or less.

Ideally, transitions between steps in the animation should be done smoothly by using an interpolated path in color space[13,14] rather than a sudden change. See Figure 4. This is essential in television graphics for a pleasing visual effect at all but the fastest speeds.

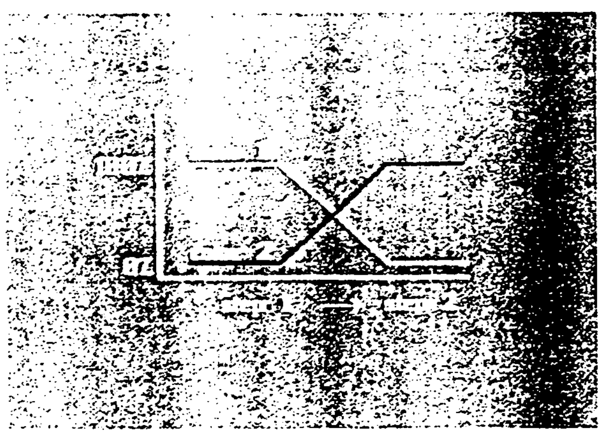

Figure 4. Linear interpolation between successive steps.

FURTHER VARIATIONS AND EXTENSIONS

Variations of color table animation are limited only by the programmer's ingenuity. For example, overlapping can be allowed by using additional pixel values to handle the areas of intersection of successive positions. Also, if a larger color space is available, several totally independent motions or speeds can be depicted by utilizing disjoint sets of colors.

If double buffering is available, a second image could be read in from disk memory while animation is underway using the first. Thus a longer animated sequence might be made up of a number of images, each of which provides a few frames of the animation via color table techniques.

THE GENERAL CASE

The animation methods described above do not readily permit very general movement, deformation, overlap of successive steps, etc. To obtain completely arbitrary motion, we can combine several frames of an animated movement into one image and allocate a different color number to every unique area in the *composite* picture. See Figure 5. Then, each frame in the animation can be displayed by simply setting the appropriate color definitions so as to make visible the areas which appear in that particular frame.

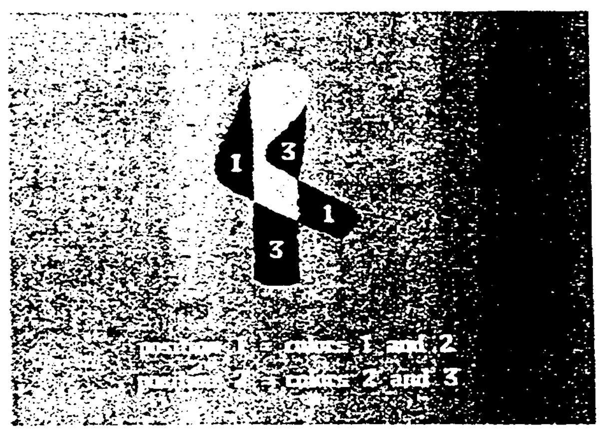

Figure 5. General case ($i=2$, $n=2$, $A=4$) with overlapping areas - bending arm.

Suppose there are i colors in an object we wish to animate (including at least one background color) and n frames in the animated movement. Since each pixel can be required to assume any of the i colors in each of the n frames, the number of distinct areas (and thus the total number of pixel values used) in the composite picture is at most $A = i^n$. If a 256-color space is being used, for example, then possible values for i, n and A are:

colors i	frames n	areas max A
2	8	256
3	5	243
4	4	256
6	3	216
16	2	256

Thus an object drawn with two colors plus background could move or deform arbitrarily in a five-frame animation cycle. In practice, however, the number of areas actually necessary is often much less than this limit since not all areas intersect all others during motion. Thus, more frames and/or more colors than indicated here may be possible depending on the content of the animation. While only a small number of colors and frames can usually be handled in this way, there are no restrictions on the kind of motion possible.

APPLICATION AND EXAMPLES

The system utilized to create these illustrations and examples was built in 1973 and developed subsequently at the Xerox Palo Alto Research Center by this author and is known informally as "SuperPaint"[15]. It provides an image of 480 x 640 pixels in a standard 525-line raster at 8 bits/pixel with a 256-word 10-bit/component color table. The color table can be updated by the program during both vertical and horizontal blanking intervals. The system can also be configured as two 4-bit/pixel frame buffers, each with its own 16-word color table and separate D/As and RGB video outputs. Standard composite video is also available via an NTSC encoder. Hardcopy output is provided via a laser-driven xerographic color printer.

The usual mode of operation maintains the menu or control panel picture in one frame buffer and the new image being created in the other. The SuperPaint software provides several different types of color table animation with interpolation, color space editing and variable speed and cueing control. Painting or pointing into the picture (with an arrow-shaped brush, for example) can take place while the animation is running in real time.

In the SuperPaint program, ten colors are used for cycling and animation and six are static or background colors. It is worth noting that only ten animating colors (or ten steps in the animation) have proved to be quite sufficient for most simple cartoon-like animated graphics of this type.

Figures 6a through 6d show various examples of color table animation created for the NASA Pioneer Venus mission in December 1978 and seen widely on television news broadcasts. Figures 7a and 7b show diagram examples created recently for the PBS television series "Over Easy".

CONCLUSIONS

Color table animation is a useful and inexpensive technique for creating real-time dynamics and animation in a frame buffer display system. Our application here is not continuous, story-telling animation, but rather short self-contained graphic communications such as diagrams, illustrations for talks, charts, title sequences, transitional material, effects, etc. Although the animation available by this means is somewhat limited, it is more than adequate to convey a rich variety of graphical ideas and concepts.

ACKNOWLEDGEMENTS

I would like to thank Bob Flegal for his early versions of thi idea and Damon Rarey for his enthusiastic use of the systen as a real graphic arts tool.

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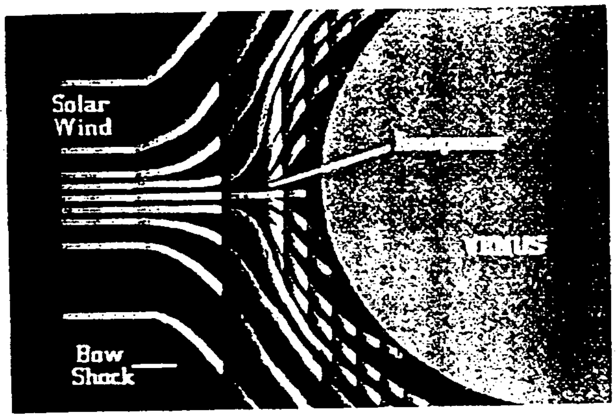

Figure 6a. Solar wind around Venus. Particles appear to move at several different speeds as they near the planet.

Figure 6b. Spacecraft insertion into orbit around Venus.

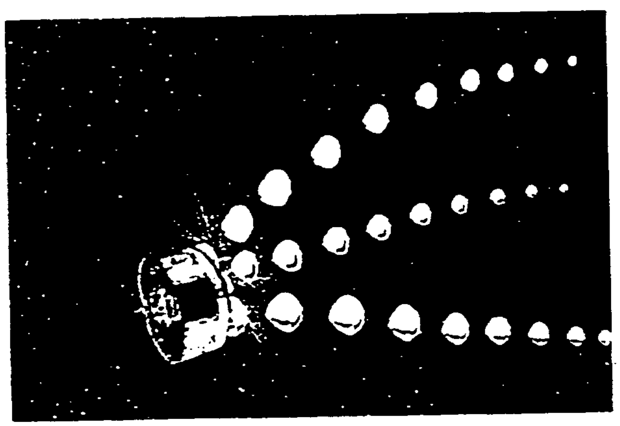

Figure 6c. Pioneer probes separating from the bus spacecraft.

Figure 6d. Venus landscape with souvenir hunter and slowly drifting clouds.

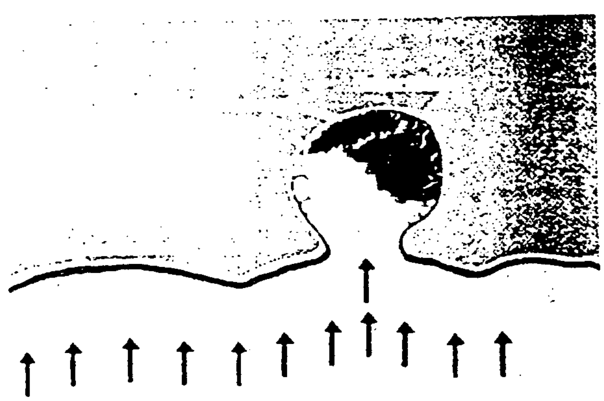

Figure 7a. Diverticulitus. Animation shows bleeding and infection spreading.

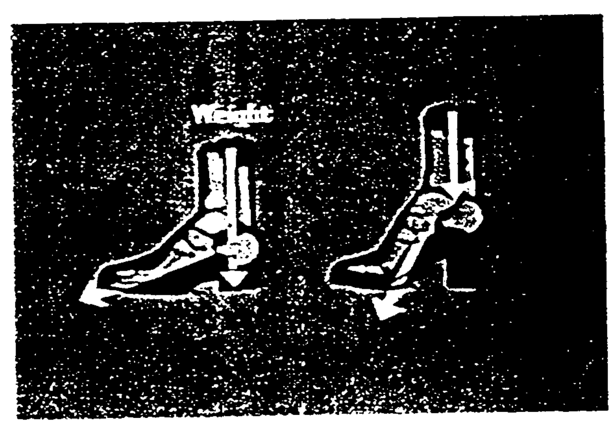

Figure 7b Weight distribution with flat and high-heeled shoes. Shoes alone, then add bones, then arrows in sequence.

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MULTIMEDIA-PC

U. SCHMIDT, FKTG

THE "Media Manager" a novel user guide for multimedia PCs

In multimedia PCs integration of individual components is not sufficient. Rather, the variety and large number of functions of the devices must be offered in such a way that the user always maintains a clear view over them. Under the title "Media Manager", this article introduces a novel user guide. It permits the basic multimedia functions of television, playing video, photo or audio CDs, listening to the radio, telephoning and scrolling through videotexts in an intuitively comprehensible way. The user does not need to become burdened down with the peculiarities of the PC operating system.

1. Introduction

Since its invention twentyfive years ago, the microprocessor technology has penetrated our entire infrastructure and shaped it from the inside out. Even the most trivial things - from the wristwatch to the egg boiler - are today being controlled by microprocessors.

The continuously advancing miniaturization, still continuing today, in microelectronics, apart from an increase in computing power, has also lead to a democratization of computing technology. For the first time it has become possible for virtually all population circles to purchase a computer for personal use: the Personal Computer was born.

The question of what a private person is to do with such a device arose immediately.

Those who posed that question completely misunderstood that in the history of technology things were not driven from above but from below. It is rather astounding to realize which oppositions and conditions fundamental inventions such as the automobile, the telephone or the airplane had to overcome. For example, the British Parliament passed a law according to which every automobile had to be preceded by a pedestrian waving a flag for the purpose of warning rural populations. Today, we find this amusing. Future generations will one day perhaps also be amused by the attempt of the government to control and direct technical developments with the aid of state media institutions and commissions to evaluate consequences of technology.

In the case of Personal Computers a development can be seen which is similar to that of the telephone: the mass-distribution of the devices also entailed as a consequence the democratization of the contents. The telephone was not, as Alexander Graham Bell had dreamed, used for the public broadcast of opera performances. Rather, it serves for the exchange of the most banal messages which could equally well have been exchanged by letter. And the PC was also not used to solve differential equations but as a device for playing games and as a typewriter, thus for applications for which solutions already existed. The success of telephone and PC, accordingly, do not rest on completely novel applications but on improvements to already available solutions: speed in communication (this also explains the success of FAX and e-mail) or for 'text correction without tears'. In exchange, clear technical disadvantages were even accepted, such as the bandwidth limitation in the case of the telephone or the typical computer print of the early matrix printer.

Currently a new device concept is taking its first steps: the multimedia PC. Critics object that the device concept is not novel rather, what is involved here is only a combination of already known components which, furthermore, are available individually and cheaper. The objection is correct but it does not penetrate to the essential core. For, apart from the integration of elements of consumer electronics,

the multimedia PC comprises features which are typical for every PC:

- It is equipped with mass background stores (hard drive, CD ROM drive)
- The PC offers high-resolution graphics.
- The PC is capable of communicating (analog modem, ISDN interface)
- The PC has an open architecture, in hardware (bus) as well as in software (operating system with interfaces for application programs).

The novelty in the multimedia PCs is the connection of these elements with rather conventional contents:

- Mass background memories until now hold volatile contents (video, audio, videotext) and, in conjunction with appropriate software, can be used like data bases.
- High-resolution graphics permit the creation of esthetically pleasing user surfaces.
- The communication capability in the form of built-in backward channel is a precondition for interactive applications.
- Standardized open hardware and software architecture permits a large number of manufacturers to present themselves as providers of solutions; this accelerates considerably the development of markets.

However, it should not be overlooked that the multimedia PC in its current state resembles a machine in its raw state. The many inherent capabilities are only made insufficiently accessible through the popular operating systems and their user surfaces. For example, these user surfaces employ metaphors which are borrowed from the world of the office (office, desk etc). They are also layed out for a maximum of expression capabilities. But, in principle, any number of simultaneous active processes are being executed at any given time. Modern operating systems open a corresponding number of overlapping 'windows' or they represent 'icons'.

This variety of expressions warms the heart of the programmer as much as the

cockpit of an older plane does that of the aircraft engineer. But just as hundreds of displays and control options of the cockpit had to make room for a 'cleaned-up' design, the complexity of a multimedia PC must today be reduced to the point where also non-programmers find handling it easy. Who knows, perhaps the programmer one day whill have to go the way of the aircraft engineer.

2. The Multimedia House

In multimedia PCs integration of single components is not sufficient; the wealth of functions of the device must be offered in such a way that the user is always able to keep track of everything. For this purpose **miro** has developed a new user guide with the title 'Media Manager', which makes the basic multimedia functions

- television,
- playing video, photo or audio CDs,
- listening to radio,
- using the telephone and
- scrolling through videotext

clearly and consistently accessible. The user remains unburdened by the peculiarities of the PC operating system. Extremely helpful was the fact that the hardware also was developed by miro itself in the form of plug-in cards for graphics, video, audio and communication. Precisely for advanced multimedia functions, such as television, radio and videotext, currently no mandatory standard interfaces exist. This shortcoming is all the more serious as the PC, in contrast to the television set, is actually not layed out for real-time processing of continuous video and audio signals. Flickering pictures full of motion and quantization artefacts are nothing new for the long-suffering PC owner. Only the simultaneous development of multimedia hardware and software makes circumventing such PC-dependent restrictions possible.

The result of this development is an architecture which can be called a 'multimedia house'. In this house, the all encompassing software roof rests on the foundation of

the four hardware functions 'graphics, video, audio and communication'. These functions are physically realized as plug-in cards, either as four single components (**Ill. 1a**) or as two compact components (**Ill. 1b**). The latter integrate on two cards the functions

- graphics processor + MPEG1 decoder + television tuner + video decoder + stereo decoder + videotext decoder + videocoder (output of graphics and video on the television set) (*miroMEDIA VIEW TV*)
- voice-capable high-speed modem (28,800 bits/s) + wavetable synthesis + UKW radio + RDS decoder (*miroCONNECT RDSradio*)

As an optional "add on" to the multimedia house, the *miroVIDEO DC20* is also an option, a motion JPEG card, which normally is used for the video postprocessing. But here it is used in connection with a large hard drive as 'digital videorecorder'. All cards are interdigitated with one another and with the roof like parts of a puzzle, symbolically as functional components of a total architecture as well as also in the literal sense: the cabling, overarching the cards of useful and control signals, ensures that all internal and external video and audio sources can send their data to all connected sinks. The PC bus alone, unfortunately, is incapable of performing in this way.

3. Design of the Media Manager

The multimedia house presents itself to the user in top view. The roof, thus the media manager, is simultaneously the user interface. Each user interface has a functional and an esthetic aspect: everything in the system takes place through them and it appears simultaneously as the system itself. The design of such an interface is thus of central importance; the degree of its acceptance decides, lastly, the success or failure of a multimedia concept.

To solve this task **miro** approached the Institute for the Arts in Braunschweig. Professor van den Boom and his associates of the chair for visualization research

accepted this challenge and designed the media manager. Within the scope of this article only the result can be introduced and discussed, for the interesting background 'theory of the studio as information environment' the reader is referred to the discussion in [1].

It was the goal of the design to design a user interface which was intuitively comprehensible in application, consistent in terms of symbols and attractive in appearance. In particular the design should be thought through consistently and not remain stuck in foreground effects. The appearance generated from these conditions of the media manager is not oriented along an object metaphor such as, for example, desk or living room, but uses an abstract and geometric form language of timeless clarity.

With respect to its functionality the media manager appears in two ways:

- The 'simple' world is characterized by complete utilization of the image space by the video signals. In addition, no operating system with the usual window world penetrates to the outside. Control takes place by remote control.
- The 'professional' world is characterized by the embedding of the multimedia functions in the normal operating system environment. Control takes place via mouse and keyboard.

This is intended to take into account two typical application scenarios in multimedia PCs: the exclusive multimedia utilization in "relaxed" position and the partial multimedia utilization during 'serious' work with the PC. For the first application, a separate remote control (Ill. 2) as well as a corresponding infrared receiver are supplied.

4. Handling the Media Manager

After calling up the media manager, the user is confronted with the implemented multimedia functions as a series of large-area stilized symbols (Ill. 3). The symbols, from left to right, represent:

- ON/OFF of media manager,
- Television,
- Video, photo and audio CD,
- Radio with RDS function,
- Telephone,
- Recorder,
- Videotext and
- Changing to the professional world.

These symbols can be selected and activated or deactivated. To select, the mouse is dragged over the symbols with a horizontal motion or the left/right keys of the remote control are actuated. This causes a red frame to jump from one symbol field to the next. Even from a relatively great distance this is still clearly visible and makes precise cursor placement superfluous. Mouse and remote control can, incidentially, be used optionally without replugging. For this purpose, mouse and infrared receiver are connected via a common cable to the serial input of the PC. A special mouse driver, in addition, recognizes from which input device the particular command originates.

The symbol selected through the red frame can now be activated by clicking on the mouse or the key "ok" of the remote control. As an optical acknowledgement, the color of the symbol changes from blue to gold. Simultaneously, the video and/or audio signals belonging to the activated device as well as a graphics control element called "control actor" are displayed. In Ill. 4 the television control actor is shown. From left to right are shown:

- The multifunction frame (extreme left rectangle), which can contain information accompanying the broadcast, for example the title of the current program.
- The record head (ball with impressed "Rec"). If it is actuated, the current program is recorded on the hard disk. The process is terminated as soon as the disk is full or the key has been pressed for a second time. If a compression

card, such as the *miroVIDEODC20*, is in the PC, the program can be recorded with full frame rate and in SVHS quality. Otherwise, a software coder is used which operates with time and space undersampling. For each recording a new file name is automatically applied by the media manager, without the user having to take care of it. The recording can later be played back by activating the recorder symbol on the symbol bar.

- The channel location selection takes place within the wide rectangle with triangles added at the top and bottom. The channels are selected by actuating the up/down keys of the remote control or by clicking on the plus/minus fields.
- Setting the volume is displayed in the narrow rectangle with inserted triangle. By actuating the up/down keys of the remote control the volume is increased or decreased. As an optical analog the red volume triangle grows or shrinks within its rectangular frame.
- The extreme right ball with impressed arrow represents the reference button to further function. If it is actuated, a supplement of the control actor with functions less frequently used is called up.

The concept of the control actor is such that all important functions of the selected device can be perceived simultaneously at a distance. For users which do not want to cover the picture by superjacent graphic symbols, the option is provided of direct access to the most frequently used function. Next to the four direction keys on the remote control (s. Ill. 2), are located the key pairs

- Channel up/down as well as
- Volume up/down.

Through the separate muting key, in addition, the sound can be switched off and switched on again at any time.

More complex functions which, as a rule, are rarely used, can be reached via the reference button. In the case of the television set, the control actor, as shown in **Ill. 5**,

is displayed again. At the extreme left are located the

- Return reference button. This ball with impressed arrow, after being actuated, changes again to its normal appearance.
- Next to it is the field for tuner, audio and video setting. In a narrow rectangle are the symbols for antenna, audio and video.
- When selecting the antenna symbol, at the right end of the actor a field with transmitter names opens. The attached hemispheres ('ears') serve for activating an automatic transmitter search or for deleting a channel location. The transmitter names are taken from the VPS signal. In addition, the transmitter names can be renamed at any time by direct entry within the field. The located transmitters can be sorted according to different groups, among them 'sport or culture', and can later be called up again.

Ill. 6 shows the appearance of the television actor for setting the image functions. In this case, the attached ears represent the functions color saturation, contrast, volume, tint, brightness and normal value setting. After selecting the corresponding ear, the particular function value can be increased or reduced with the triangle.

In **Ill. 7** the playback of a video CD is shown. In this case, the multifunction frame contains data regarding the title and playing time. The rhombic symbol on the actor bar contains in the horizontal the drive functions reverse, pause, forward, and in the vertical direction the jump to the next (+) or previous (-) title. The button with the impressed rectangle represents the stop function.

Ill. 8 shows the use of the radio. The structure of the radio actor resembles that of the television actor, however, in the multifunction frame is located the radiotext broadcast in the RDS signal. On the symbol bar, incidentally, can be seen that currently the television as well as also the radio are activated. In this case, one video and two audio signals are active. Switched through is in every instance the signal of the selected device. A left/right motion is sufficient in order to move back and forth

between television sound and radio sound. A further example would be the simultaneous activation of television set and video CD. In this case, through the selection of the device video and audio would be switched. It is, of course, possible to have more than two devices active simultaneously. Dragging over the symbol bar from left to right would switch successively television sound, CD sound, radio sound and telephone sound to the loudspeakers. Each selected picture and each selected sound can be recorded spontaneously on the hard drive by means of the recording button. It is precisely this extremely easy change between the various multimedia functions which allows the untrained user to master the complexity of modern multimedia end devices.

In **Ill. 9** somebody is telephoning while in the background the television picture continues to run. The telephone number can be selected either from a previously stored list or by entering it from the keyboard. The actuation of the button with the telephone receiver starts the selection process and also terminates the call again. Used is either the supplied telephone device, the *miroCONNECT RDSradio*, or a connected hand apparat.

Ill. 10 lastly, shows the use of videotext. It is stored in a multistage process (card memory, main memory, hard drive) such that the desired pages are available virtually immediately. When not using the television tuner, pages are automatically loaded or updated in the background. Within one videotext page by selecting a page number it is possible to branch to this page.

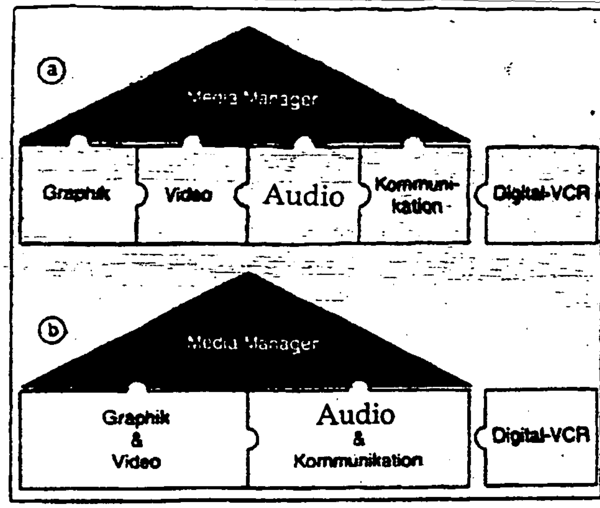
In **Ill. 11** the symbiosis of media manager and 'serious' application is shown as it is displayed after actuation of the reference button on the symbol bar. Above a text processing program which is used in the customary way, is a reduced edition of the symbol bar and television picture; the sound continues in the background. Image and bar can be 'touched' and moved with the mouse. This allows the continuation of working with the PC with the simultaneous - even if restricted - use of the

multimedia selection. Changing to the 'simple' world with the full utilization of the screen for the television signal is possible at any time by actuating the reference button again.

5. Prospects

Extensive discussion of a multimedia application as offered by the media manager is here only possible within limits. The time component, so essential, is absent here, which converts a sequence of static situation description into a dynamic application experienced as an effortless whole. The sense of effortlessness is only achieved if certain time thresholds known from the field of psychology are not exceeded. Dealing with a multimedia PC is only perceived as being pleasant if one never needs to wait. This important condition is taken into consideration by the media manager through a concept of minimum expenditure in the selection of change of functions as well as by permitting any number of simultaneously active video, audio and text sources.

In function and appearance the media manager is designed for expansion. As the roof of the multimedia house it will in the future integrate further functions, for example Sat-TV, DVB, DVD or internet. Within the control actor further setting possibilities can be accommodated. Both expansion capabilities find their visual counterpart in the principle of row addition as expansions of the symbol bar or the actor bar. The functional and clearly structured graphic symbols as well as the remote control were designed specifically for this purpose. They permit dealing with the multimedia PCs in an extremely easy way but one that is not in the foreground as an end in itself. Whether or not out of today's multimedia PC a completely independent multimedia PC will develop in the future, only the future will show: first hopeful signs can be observed.



Ill. 1 The multimedia house
a) Component construction (4 slots)
b) Compact construction (2 slots)

Ill. 2 Remote control of media manager

Ill. 3 Basic image of media manager with symbol bar

Ill. 4 Television with the media manager

Ill. 5 Television picture with control actor, return reference button and additional setting aids

Ill. 6 The video functions can be adjusted via the television actor.

Ill. 7 User surface for playing a video CD

Ill. 8 The radio text can be read and also recorded in radio function

Ill. 9 Telephoning and watching television at the same time

Ill. 10 Videotext use can also be simplified - and simultaneously accelerated

Ill. 11 Symbiosis of media manager and professional use

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